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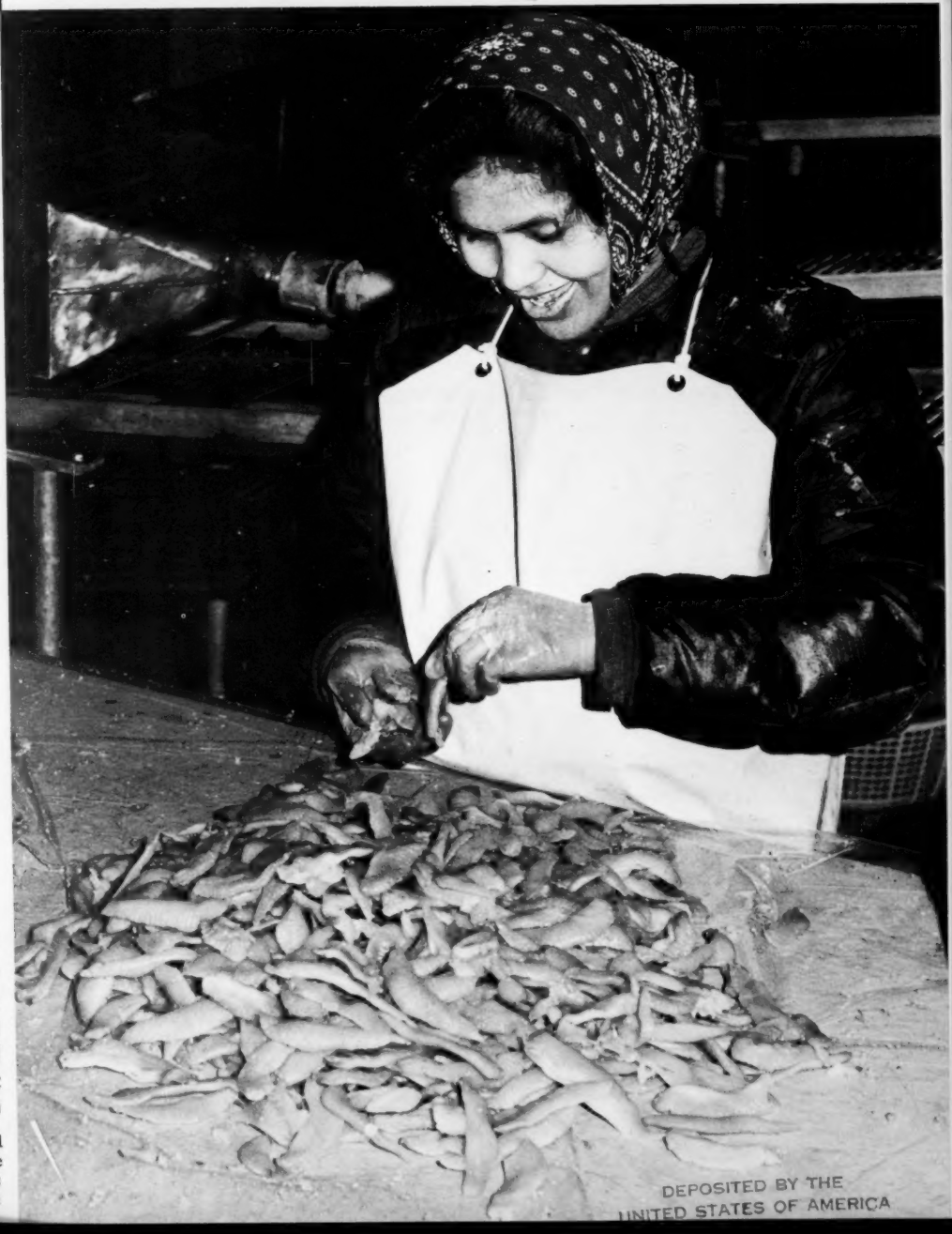

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NATIONAL MARINE FISHERIES SERVICE
Philip M. Roedel, Director

COVER: Worker at Sitka, Alaska, processing plant inspects herring roe before it is packed for shipment to Japan.
(NMFS-Alaska Photo: J.M. Olson)

COMMERCIAL FISHERIES

Review

A comprehensive view of United States and foreign fishing industries--including catch, processing, marketing, research, and legislation--prepared by the National Marine Fisheries Service (formerly Bureau of Commercial Fisheries).

Fishermen's Memorial
Gloucester, Mass.

Editor: Edward Edelsberg

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Throughout this book, the initials NMFS stand for the NATIONAL MARINE FISHERIES SERVICE, part of NATIONAL OCEANIC AND ATMOSPHERIC ADMINISTRATION (NOAA), U.S. Department of Commerce.

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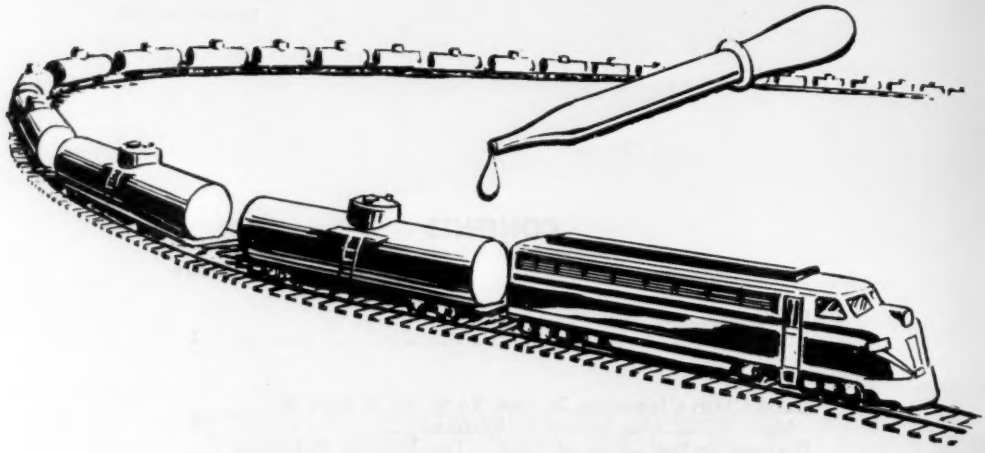
CONTENTS

	Page
UNITED STATES	
Events and Trends	1
ARTICLES	
Hard Clam Cleansing In New York, by Robert B. Mac Millan and James H. Redman	25
Disease in the Lives of Fish - The Role of Pollution Is Now Being Assessed, by Richard Wolke	34
Taiwan's Use of Fishery Resources, by Yung C. Shang	38
How To Instal An Echo Sounder In A Small Fiberglass Boat, by Larry D. Lusz	44
The Separation of Crab Meat From Shell & Tendon By A Centrifugal Process, by Wayne I. Tretsven	48
INTERNATIONAL	50
Asia	57
Europe	63
RECIPES	70
INDEX	72



Laboratory tests reveal that some pesticides in fantastically small amounts kill crabs and shrimp. One part of DDT in a billion parts of water will kill blue crabs in 8 days. (One part per billion is about the relationship 1 ounce of chocolate syrup would bear to 1,000 tank cars of milk.)

Commercial brown and pink shrimp, exposed to a 0.3 to 0.4 part of heptachlor, endrin, or lindane in 1 billion parts of water were killed or immobilized in 48-hour laboratory tests. In the laboratory, paralyzed fish or shellfish may live for days, even weeks. But in the sea, where only the fittest survive, death may result almost immediately.

PESTICIDES PERIL OCEAN LIFE, SCIENTISTS WARN

Up to 25% of DDT compounds so far produced "may have been transferred to the sea," a Panel of the National Academy of Sciences has reported in "Chlorinated Hydrocarbons in the Marine Environment."

The scientists emphasize: "This report is not intended to represent an exhaustive survey of the literature. It has been prepared to alert the community of marine scientists to one of the more serious problems arising from the dispersal of man's materials to his surroundings. Emphasis has been placed upon DDT and its degradation products because they have been the most studied to date."

The amount of DDT compounds in the living things of the sea is estimated at below 0.1% of total production. But even this small percentage has had a "demonstrable impact upon the marine environment."

Bird populations that eat fish have failed to reproduce and have declined. And, as greater quantities of persistent chlorinated hydrocarbons accumulate in the marine ecosystem, more species will be threatened. These pollutants will reach "unacceptable levels" in the tissues of marine food fish.

Long-Lasting Harm

The experts state that it is very hard to set an exact figure on certain risks involved in using chlorinated hydrocarbons, but these risks require serious consideration. The rate at which such substances become harmless is unknown, but some of the more persistent materials remain deadly for years, even decades or centuries.

The future may hold even greater peril for marine life. If most of the remaining 75% of the persistent chlorinated hydrocarbons is now in reservoirs, but in time will reach the sea, then marine organisms will take in greater amounts despite improvements in future manufacturing practices. If these compounds last longer than decades, it will be virtually impossible to undo the damage.

In a grim cautionary note, the Panel states that the story of pesticide problems has revealed unexpected effects in the past decade. "Our prediction of the potential hazards of chlorinated hydrocarbons in the marine environment may be vastly underestimated."

PANEL RECOMMENDATIONS

The NAS Panel recommends:

- An extensive and immediate U.S. effort should be made to drastically reduce escape of persistent toxicants into the environment. The goal would be to virtually end this escape as soon as possible.

- Design programs to: determine entry rates of each pollutant into oceans; make base-line determinations of how these pollutants are distributed in the different parts of that environment. Later, a program should be devised to monitor long-term trends to see what progress has been made--"and to document possible disaster."

- Because the evidence shows some of these substances degrade the environment, the laws covering registration of chemical substances and release of production figures by government "should be examined and perhaps revised."

U.S. & WORLD PRODUCTION OF CHLORINATED HYDROCARBONS

Th U.S. uses about 30% of its production of DDT and 70-80% of its production of the aldrin-toxaphene group: aldrin, chlordane, dieldrin, endrin, heptachlor, and toxaphene.

World production data are hard to obtain because the available information is inadequate. But FAO data in 1969 suggest "that the total world production of DDT and the aldrin-toxaphene group is probably no more than one and one half times that of the U.S."

It is "even more pressing" to learn the production figures for the polychlorinated biphenyls, which have been used since the early 1930s.

PANEL ON MONITORING PERSISTENT PESTICIDES IN THE MARINE ENVIRONMENT

of the

COMMITTEE ON OCEANOGRAPHY

NATIONAL ACADEMY OF SCIENCES

Edward D. Goldberg, Chairman
Philip Butler
Paul Meier
David Menzel
Gerald Paulik
Robert Risebrough
Lucille F. Stickel

ROUTES OF DDT RESIDUES + PCBs TO MARINE ENVIRONMENT

After DDT is applied on land, its residues make their way to the ocean via rivers, sewage outfalls, and the atmosphere. DDT residues are DDT, DDE, and DDD. DDD and DDE are metabolites of DDT; DDD itself is a pesticide.

DDT residues reach the atmosphere in several ways: aerial drift during application by rapid vaporization from water surfaces, and by vaporization from plants and soils. When they are in the atmosphere, DDT residues may travel thousands of miles. They enter the ocean in precipitation or in dry fallout. The NAS Panel states: "There are few data for estimating these rates of transfer."

DISTRIBUTION OF CHLORINATED HYDROCARBONS IN MARINE ENVIRONMENT

There are few data to document concentration of chlorinated hydrocarbons (including PCBs) in open-ocean environment. But some observations reveal that DDT and its residues are probably distributed throughout marine biosphere.

- Gray whales concentrate up to four tenths (0.4) of a part of DDT residues in a million parts of their blubber. These whales feed largely on bottom-dwelling organisms in the Chukchi and Bering Seas. Sperm whales feed on larger open-sea organisms.

- Sea birds--petrels and shearwaters--feed on planktonic organisms far from land. Their concentrations of DDT residues run as high as 10 ppm.

- Such migratory fish as tuna harbor as much as 2 ppm in their gonads. Other marine mammals carry as much as 800 ppm in their fat. It is not known whether these concentrations resulted from localized contact in coastal waters--or were accumulated during their life in the open ocean.

- In the coastal environment, DDT and its residues range from undetectable levels to 5.4 ppm in oysters. Concentrations within these limits are highly variable, even within same estuary.

ECOLOGICAL IMPACT

The NAS Panel states: "The acute and chronic toxicity of chlorinated hydrocarbons has been identified by observing the effects of chlorinated hydrocarbons under controlled laboratory conditions. The exposure of test populations of marine fauna to several dilutions of these pollutants in flowing seawater has shown that they affect growth, reproduction, and mortality at concentrations currently existing in the coastal environments."

PLANKTON

Adding chlorinated hydrocarbons to laboratory cultures of molluscan larvae--and the phytoplankton they eat--causes (with increasing concentrations) "decreased growth rates, developmental failures, and increased mortality."

In one southeastern U.S. estuary, toxaphene levels were high enough to have killed most of phytoplankton suitable as food for molluscan larvae.

In the open ocean, phytoplankton are the base of the food chain. They may be primary concentrators of chlorinated hydrocarbons from the water.

CRUSTACEANS

In bioassay tests, laboratory populations of commercial species of shrimp and crabs, and zooplankton, are killed by exposure to chlorinated hydrocarbons, such as DDT and PCB, in parts per billion (ppb).

Exposing shrimp continuously to DDT concentrations of 0.2 ppb killed all of them in 18 days. A concentration of 0.12 ppb killed all in 28 days.

Such concentrations have been found in Texas rivers flowing into commercially important shrimp nursery areas. In such contaminated areas, there are significant mortalities of juvenile crustaceans.

In California, declining production of Dungeness crabs "may be associated" with DDT residues in the developing larvae.

Polychlorinated biphenyls (Aroclor 1254) at 5 ppb killed 72% of test populations of pink shrimp (Penaeus duorarum) in 20 days. These shrimp had accumulated 33 ppm of PCB in their tissues.

MOLLUSKS

The chlorinated pesticides and PCBs hinder oyster growth. One ppr of PCB Aroclor 1254 produces 20% decrease in shell growth.

Many pesticides interfere with oyster growth at levels as low as 0.1 ppb.

Mollusks concentrate these chemicals. They indicate pollution levels in marine waters. Monitoring coastal samples have shown that amount of chlorinated hydrocarbon residues in mollusks are correlated directly with application rates of these agricultural chemicals in adjacent river basins.

FISH

Nearly the world over, marine fish are contaminated with chlorinated hydrocarbon residues. There are expected concentrations in such lipid tissues as the ovary.

On the south Texas coast, in speckled sea trout, DDT residues in ripe eggs are about 8 ppm. This level may be compared with residue of 5 ppm in freshwater trout that causes 100% failure in development of sac fry or young fish.

"The evidence is presumptive for similar reproductive failure in the sea trout." In Texas's Laguna Madre, sea-trout inventories declined progressively from 30 fish per acre in 1964 to 0.2 fish per acre in 1969. Few juvenile fish have been observed in recent years. But only 100 miles away, in less contaminated estuaries, the distribution of sea-trout year-classes is normal.

In California, the sale of some mackerel has been banned because DDT residues were too high, even in the processed fish.

In the Mississippi River, in 1963-64, a large fish kill was traced to chemicals entering river system from insecticide-manufacturing plant. Very high endrin amounts were found in nearby sewers and in riverside dump.

Laboratory experiments showed that concentration of several chlorinated hydrocarbons, including DDE, damage reproductive success of birds, fish, and marine invertebrates.

BIRDS

"Chlorinated hydrocarbon residues have seriously affected both adult birds and their reproduction."

Deaths of bald eagles, common loon, and peregrine falcons have been correlated with deadly amounts of chlorinated hydrocarbons in body tissues.

In the Netherlands, many coastal birds died and the population of sandwich tern declined. This was traced to dieldrin

contamination of Dutch Wadden Sea and coastal North Sea resulting from factory effluent.

In the Baltic Sea, sea eagle reproduction has failed and deaths occurred because of very high levels of DDT compounds and PCB in the tissues.

Studies of museum series of eggs showed that, since mid-1940s, eggshell thinning has occurred in many species of fish-eating birds and birds of prey. Where there was shell thinning, the population usually declined. Eggshell thinning and the population decline that followed were linked to chlorinated hydrocarbon residues in eggs and in body tissues of birds.

In U.S. Atlantic Coast sites, black duck egg samples showed highest residues of chlorinated hydrocarbons in states where duck reproduction is poorest.

In southern California's marine ecosystem, concentrations of DDT compounds in fish may be greater than 10 ppm. In 1969, there was a catastrophic failure of reproduction among brown pelicans on Anacapa Island as a result of egg-shell collapse.

BIOCHEMICAL EFFECTS

The Panel states that "several physiological effects of chlorinated hydrocarbons could account for shell thinning and for the abnormal behavior observed in contaminated populations."

When they affect nerves, the chlorinated hydrocarbons, including DDE, "are believed to block the ion-transport process by inhibiting one or more ATPases in the nerve membrane that causes the required energy to be made available."

RECOMMENDATION: A NATIONAL EFFORT TO CURTAIL LONG-TERM EFFECTS OF CHLORINATED HYDROCARBONS ON COMMUNITY STRUCTURE

The Panel makes clear that these changes in the earth's living systems are part of an even more portentous pattern of changes in the "structure of the natural communities of estuaries, coastal regions, and the oceans." The familiar pattern is connected with stepped-up eutrophication and pollution of water bodies.

In the water, simplified communities of eutrophic lakes and estuaries develop. Harvestable fish populations often are depressed. Bird populations are dominated by scavengers, such as the herring gull.

The problem in the water is greater than that on land. This is because reduction of consumer populations is accompanied by a shift in plant species to hardy algae. The algae are not eaten by grazers. Worse, their production accumulates. There is less oxygen. And, the potential of the area to support man further diminishes.

Many factors cause these changes. But, the Panel states, the building up of persistent chlorinated hydrocarbons in estuaries and in coastal waters have made these agents major factors in speeding this pattern of change.

The Panel recommends: "A massive national effort to effect a drastic reduction of the escape of persistent toxicants into the environment, with the ultimate aim of achieving virtual cessation in the shortest possible time. Only in this way can we hope to curtail the deleterious effects of chlorinated hydrocarbons upon community structure."

RECOMMENDATION: A CHLORINATED HYDROCARBON BASE-LINE PROGRAM FOR THE MARINE ENVIRONMENT

There has been little analysis of chlorinated hydrocarbons in materials from the marine environment--and from parts of atmosphere and continental hydrosphere that provide these pollutants to the waters.

An effective monitoring program cannot begin "until the present dissemination of these materials at the earth's surface is detailed." A beginning can be made with a reasonable monitoring program by using a base-line study. This would determine concentrations of chlorinated hydrocarbons in geological and biological components of the marine environment, and in their transporting agencies. "Such an investigation can conceivably be carried out in a year."

The Panel believes that using a single laboratory to manage the program would minimize standardization problems of sample preparation and handling. It thinks of a thousand analyses during the first year's base-line program. "Temporal, geographic, and

spatial sampling procedures will be formulated for each of the groups of substances."

RECOMMENDATION: REMOVAL OF OBSTACLES TO PUBLIC ACCESS TO CHEMICAL PRODUCTION DATA

The NAS Panel lists among the causes contributing to lack of available data on chlorinated hydrocarbons a legal structure: when there are no more than 2 producers, they can withhold production figures as privileged information.

The scientists believe that "it is not in the public interest for government to maintain as privileged data that are necessary for research into the state of our environment and for an assessment of its condition."

And the Panel concludes: "We recommend that the laws relating to the registration of chemical substances and to the release of production figures by the Department of Commerce and the Bureau of the Census be reexamined and revised in the light of existing evidence of environmental deterioration. The protection afforded manufacturers by government is an artificial obstacle to effective environmental management, particularly with reference to the polychlorinated hydrocarbons. In view of other impediments--technological, methodological, and financial--such protection is clearly inappropriate."

Where the concentration of DDT is as low as 10 parts in a trillion parts of water, the oyster collects and stores the pesticides. Oysters have stored DDT during a 40-day exposure period to levels 70,000 times greater than a 0.1 p.p.b. concentration in surrounding water. Put back in clean water, oysters can, in time, eliminate the pesticide.

1 2 3

Typical effects of pesticides on growth of experimental oyster shell after 96 hours.

1. Control oyster with about one-fourth inch of new growth.
2. Oyster where exposure to a pesticide decreased growth by about 50 percent.
3. Oyster in which pesticide was so toxic it prevented any new shell formation.

The illustrations in this article come from "FISH, WILDLIFE and . . . PESTICIDES," written by Edward Edelsberg for Fish and Wildlife Service.

PUBLIC SHOULD CONTINUE TO EAT FISH & SHELLFISH, NOAA ADMINISTRATOR SAYS

Fish should remain a very worthwhile part of the American diet, Dr. Robert M. White, NOAA Administrator, recently told the Shellfish Institute of North America. He said it would be "needless and tragic" if the finding of mercury in a small number of fishes caused consumers to avoid all fish.

Dr. White emphasized: "There is no reason whatever not to eat--and enjoy--fish and shellfish."

Pledges Full Study

He pledged that NOAA's National Marine Fisheries Service (NMFS) will try to find out quickly and thoroughly the extent of mercury or other heavy metals in fish. NMFS will "keep the public informed, not only of those products with high levels but those which fall below the guidelines offered by the Food and Drug Administration."

Dr. White said NOAA works closely with the Food and Drug Administration (FDA) to help protect the public against fish contaminants. He added: "So far, what we have found gives us reason for optimism. Since the mercury problem first came to light about a year ago, swordfish is the only species that the FDA felt should be the subject of a warning to the public.

"I have faith in the common sense of the American people. I am confident that they will be guided by specific cases and will not deprive themselves of the nourishment, the economy, and the pure enjoyment of eating the vast majority of fish, which there is no reason to distrust."

SHELLFISH SITUATION

Richard W. Surdi & Donald R. Whitaker
NMFS Current Economic Analysis Division

Supplies of all shellfish, except calico scallops, decreased during the first 3 to 4 months of 1971. The lower level of imports this year, especially for shrimp and northern lobsters, has been a major reason for the present lack of supplies. Although imports of scallops from several countries and imports of lobster tails from Australia and South Africa increased, most shellfish-producing nations are experiencing declining catches; so U.S. imports have declined.

In addition to lower imports, domestic landings have been down during the first months of 1971. This drop has been due to several factors, including bad weather and lower abundance.

Another supply complication has been the rapid decline in holdings of frozen shellfish. Cold-storage holdings generally decline during the first part of the year for most species. During the first 4 months of 1971, however, the rate was much more rapid than in previous years. To satisfy the market, and to compensate partially for declining imports and landings, processors and retailers have drawn heavily from inventories. Consumption of shellfish during the early months of 1971 was about the same or only slightly below 1970. This stability is especially impressive in light of the sharp gains in prices for most species and the lower quantities available to be consumed.

The increase in prices has affected domestic and imported shellfish. While U.S. and world demand has continued to rise, relatively stable or declining supplies have boosted import prices.

OUTLOOK

The shellfish outlook during May-July was for continuation of the first 4 months' trends. Supplies were expected to remain below 1970. Rising prices at record levels and expected lower supplies probably would keep consumption at 1970 level. Demand, however, probably would remain strong.

Shrimp

Sales of fresh and frozen shrimp during January-April 1971 were a little over 100 million pounds, heads-off weight--a gain of about 2% from 1970. Sales were impressive in view of the early months of 1971.

The importance of shrimp inventories was never more evident than in the first 4 months. U.S. shrimp landings were down about 3 million pounds from January-April 1970. Shrimp imports declined 14 million pounds in the same months. Despite declines in landings and imports, sales actually gained a little over last year. The gain was possible because of inventory withdrawals. Between January 1 and May 1, 1971, inventories of frozen shrimp dropped 28 million pounds--15 million more than last year. Thus, inventories made up practically all the deficit in landings and imports. Exports of shrimp were also down in the first four months. This made more shrimp available for the domestic market. The combination of these supply factors enabled sales to gain a little in January-April.

If imports continue to decline, it will be difficult for sales to remain at year-ago levels. Inventories cannot continue to make up the import deficit. Preliminary indications pointed to another decline in imports in May--the sixth consecutive month imports have fallen below corresponding months in 1970. Shrimp landings in the Southern States during the summer are expected to be no higher than last year.

Unless imports show a quick turnaround, shrimp sales this summer likely will be off from last year.

Scallops

Supplies of sea scallops were 7.9 million pounds during the first 4 months of 1971. This was a slight decrease from a year ago. January-April landings of 1.4 million pounds were about 18% below same period in 1970. A slight

increase in imports partially offset the decline in domestic landings. Increases in imports from the United Kingdom and several other countries compensated for a large decline in shipments from Canada.

Consumption of sea scallops at 6.2 million pounds during January-April was 5% below 1970. The decline can be attributed to lower supplies and higher prices.

Supplies of sea scallops during the summer are expected to continue lower than in 1970. Domestic landings likely will continue low. Although the high prices of scallops would seem to indicate the probability of higher imports, this is unlikely because of the declining trend in imports from Canada. Increases in imports from other countries may just offset the Canadian decline.

Northern Lobsters

Supplies of northern lobsters at 5.8 million pounds, live weight, were 7% below first-quarter 1970. Maine landings fell 13% to 611,000 pounds, and compelled wholesale dealers to rely primarily on "pound" lobsters. Imports from Canada declined 6%.

The quantity demanded during first-quarter 1971 was light due to record high prices. Exvessel prices generally rise for the first 3 months of the year and then fall in April. Prices paid to fishermen not only rose an unusual amount, 32 cents during January-March, but continued to rise into April.

Lobster landings, which are seasonally low in the first quarter, generally increase in April and rise steadily until the peak in September or October. Prices normally drop during May, then rise during June and July. The normal seasonal pattern is expected to be followed this year but at a higher level than a year ago.

Spiny Lobster Tails

Supplies of spiny lobster tails were 17 million pounds during first 4 months of 1971--down about 2.5 million pounds from last year. Most of this decline resulted from lower inventories. Imports were higher in the first quarter but dropped in April. Inventories have been averaging about 40% lower than a year ago.

Demand has been strong. Sales were above the previous year during the first quarter despite sharply higher prices. At 10.2 million pounds, sales were up about 9% during January-March. Consumption, however, fell nearly 20% in April; the April decline resulted mainly from lower supplies. Prices of lobster tails have risen sharply in 1971--$.60 to $1.00 higher than in 1970.

Supplies of spiny lobster tails are expected to continue lower than a year ago during the summer; prices may edge up a little more from May levels and average well above a year ago.

West Coast Crabs

Production of West Coast crabs was off sharply in first-quarter 1971. Total landings were an estimated 32 million pounds compared with 49 million pounds in January-March 1970. Landings of dungeness and snow crabs were about half those a year ago, while king crab landing were marginally higher.

With generally shorter supplies likely in 1971 for West Coast crabs, some gradual strengthening in prices is likely this summer, especially for king and dungeness crabs. With prices of most shellfish at record high levels, and supplies generally lower, the possibility exists for some substitution of crab products.

A SABLEFISH FISHERY MAY BE POSSIBLE OFF CALIFORNIA

Two collapsible sablefish pots, developed by NMFS Seattle, were bought and assembled by NMFS Fishery-Oceanography Center, La Jolla, Calif. The pots measure 96"x 33"x 33". The large catches of sablefish (Anaplopoma fimbria) reported by Seattle base indicate that the pots fish more efficiently than standard longline gear.

Abundant Off S. California

The fish apparently are abundant off southern California in 100-500 fathoms. The main product in the U.S. is sold smoked, but local restaurateurs and fish dealers have shown interest in marketing the fresh product.

In the past, sablefish landings in southern California have been almost zero. R. Green of La Jolla is trying to interest local fishermen in making trial market catches.

JUVENILE JACK MACKEREL ADAPT TO FOOD DEPRIVATION

As part of its study of the ability of juvenile fish to survive food deprivation, NMFS La Jolla completed measurements of the respiration of starved jack mackerel. The researchers found that the basal level of respiration did not differ significantly from control, well-fed fish; it indicated that food energy is used up at about the same rate during starvation.

The Testing

The starved fish lost weight and 2-3g of body fat. But, after 45 days, these fish still were able to swim at sustained speeds only slightly slower than well-fed fish. This took place in an exercise machine where swimming speed was controlled. However, there was a behavioral adaptation to starvation: the juvenile jack mackerel, when permitted, reduced their overall swimming activity. Feeding began as soon as food was given to the starved fish. An increase in overall swimming became evident immediately.

NOAA AWARDS GRANT FOR PACIFIC ADVISORY PROGRAM

NOAA has awarded a $36,500 Sea Grant to support a Pacific Sea Grant Advisory Program (PASGAP). The program seeks to help many users of marine resources whose work carries them beyond the boundaries of a single state.

The NOAA grant went to Oregon State University, Corvallis. It will be administrator for 6 other participants: universities of Alaska, British Columbia, California, Hawaii, Washington, and National Marine Fisheries Service.

Fishermen of the northeastern Pacific usually seek certain species over wide areas. Often it is difficult to pass along to them useful extension advisory services. The salmon troll fleet ranges from California in the spring to Alaska in the summer and fall. Albacore tuna fishermen travel from Baja California to Vancouver Island.

The new NOAA-supported program will tie the productive marine advisory programs already in operation from Alaska to California. These programs are spurred by Sea Grant and state, provincial, and local programs.

Already, PASGAP has produced, with the participating groups, the first Commercial Fishermen's Directory of Emergency Services, and an inventory of publications and films on marine resources.

The NOAA grant will help produce more publications, conferences, and workshops geared to provide timely information to marine-resource users.

CALIFORNIA'S ANCHOVY-FOR-REDUCTION SEASON CLOSED MAY 15

California's open fishing season for anchovy to be reduced into meal, oil, and solubles, which began Aug. 1, 1970, was closed at midnight May 15, 1971. Nearly 80,000 short tons were landed, only about 73% of 110,000-ton quota, reported California's Department of Fish and Game.

In the last 4 open fishing seasons, landings were 83,473 (1969-70), 28,050 (1968-69), 6,506 (1967-68), and 37,615 (1966-67) tons.

NMFS PREDICTS GOOD ALBACORE FISHING OFF SOUTHERN CALIFORNIA

Commercial and sport fishermen should have a good albacore season in California coastal waters south of San Francisco, predicts Dr. R. Michael Laurs, NMFS laboratory in La Jolla, California.

Based on the historical trend of commercial albacore catch distribution and environmental conditions, commercial fishermen will catch an estimated 25 to 35 million pounds south of San Francisco, and 15 to 22 million pounds north of it. Sport boats will do well in southern California waters.

Favorable Conditions

Dr. Laurs and his colleagues say that there will be cooler-than-average sea-surface temperatures on the U.S. west coast particularly in the northwest; and stronger-than-normal north-northwest winds. These conditions favor local biological enrichment of the ocean and adequate food for the migrating tuna.

Dr. Laurs explained that the commercial albacore fishery was centered south of San Francisco during 1960-64. It shifted to Pacific Northwest in 1965 when ocean temperature in this area indicated a warmer-than-normal trend. The northward swing peaked in 1968: 85% of west coast catch was north of San Francisco, mainly in Oregon and Washington waters. In 1970, only about 65% of west coast commercial catch was north of San Francisco. It appears albacore fishing will continue return towards waters south of San Francisco.

Cruise Updates Information

To keep forecast information up to date, NMFS fishery biologists, meteorologists, and oceanographers, under Ron Lynn, were scheduled to leave San Diego, Calif., about June 28, aboard NMFS research vessel 'David Starr Jordan' for 19-day cruise to study migration route of albacore into U.S. coastal waters from central Pacific. The scientists were to troll jiglines and observe life history of albacore by studying age, length, weight, sex, stomach contents, and other statistics.

Also, observations would measure distribution of oceanographic features associated with albacore migration. Included would be plankton net hauls to obtain estimates of food available for albacore.

The commercial fishing vessel 'Typhoon' was slated to leave Newport, Oregon (about June 15) to make a preseason scouting survey 400 to 500 miles offshore from about Cape Mendocino southward to Erben Bank. Periodically, the Typhoon would radio sea-surface and subsurface temperature data and fishing information to Dr. Laurs at La Jolla via radio station WWD.

AVERAGE SEA SURFACE TEMPERATURE

The 11-year average (1960-70) of the optimum temperature zone for albacore for July 1-15 is shaded in Figure 1. The bulk of albacore are taken in this temperature range. Prevailing weather during July 1-15, 1971, "will no doubt cause deviations from this average pattern," which will influence albacore distribution. NMFS La Jolla will monitor evolving temperature patterns to project distribution as season develops.

RECENT TRENDS IN OCEANIC & ATMOSPHERIC CONDITIONS

The latest available observational data indicate that sea-surface temperatures along U.S. west coast from Vancouver Island to tip of Baja California--and out to longitude 135° W--are 2° (F) below average temperatures computed for past 10 years. These below-average conditions continue a pattern that has persisted since January 1971. The 60° isotherm normally begins northward advance between 125° W and 135° W in May; this year, it appeared to start earlier and reverse cool trend. But the momentum of early warming was short-lived: the 60° isotherm was still well south of its normal location in second half of May (Figure 2). These short-term events at beginning of the warming season help little to project probable distribution of sea temperature in mid-summer. NMFS La Jolla cautions that continued monitoring and careful interpretation may lead to forewarning of changes in trends over longer periods.

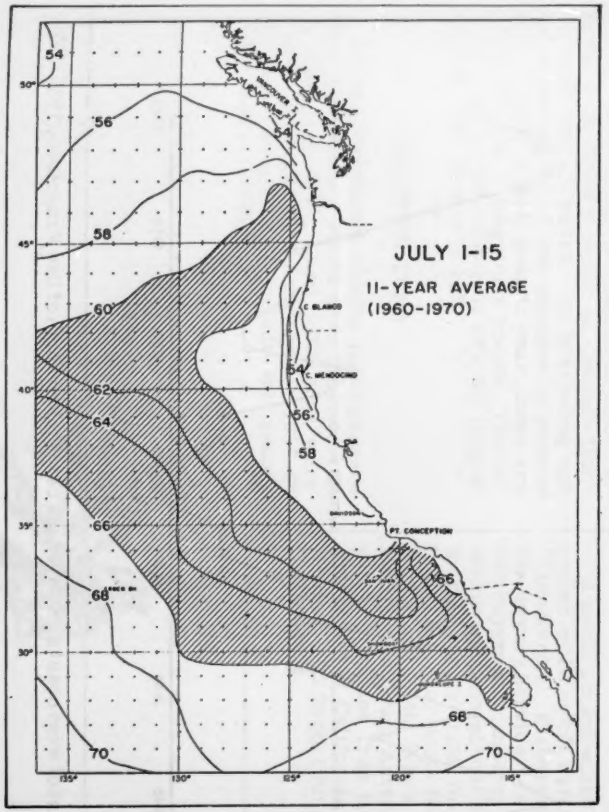


Fig. 1 - Average sea surface temperature fields for the July 1-15 interval. Shaded zone delineates region where most of the albacore would be available under these conditions.

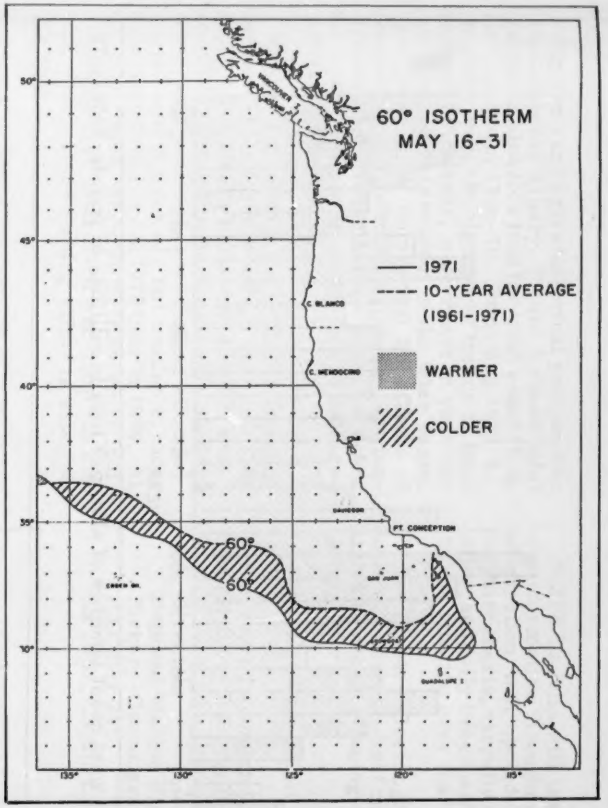


Fig. 2 - Relation of position of May 16-31, 1971, 60° F limiting isotherm to long-term average position for the same interval.

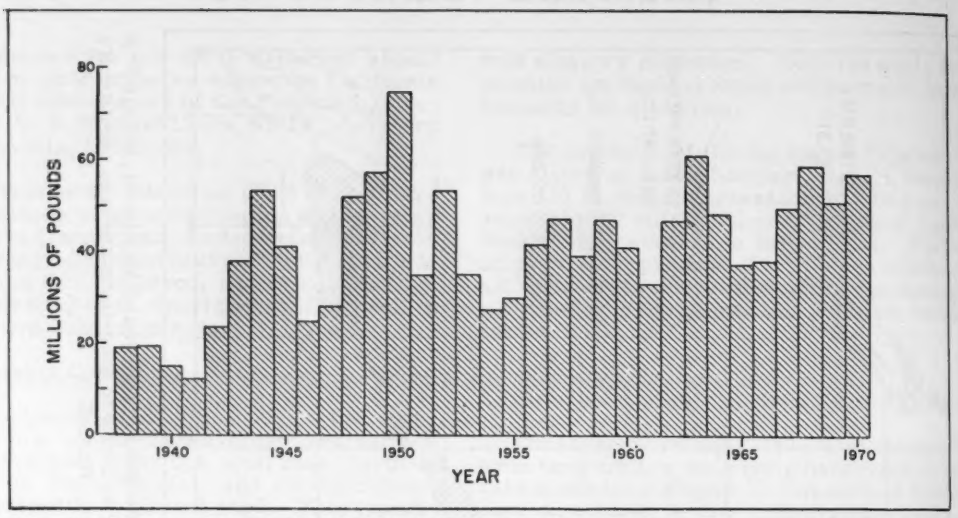


Fig. 3 - Total west coast landings of albacore tuna in millions of pounds, 1938-1970.

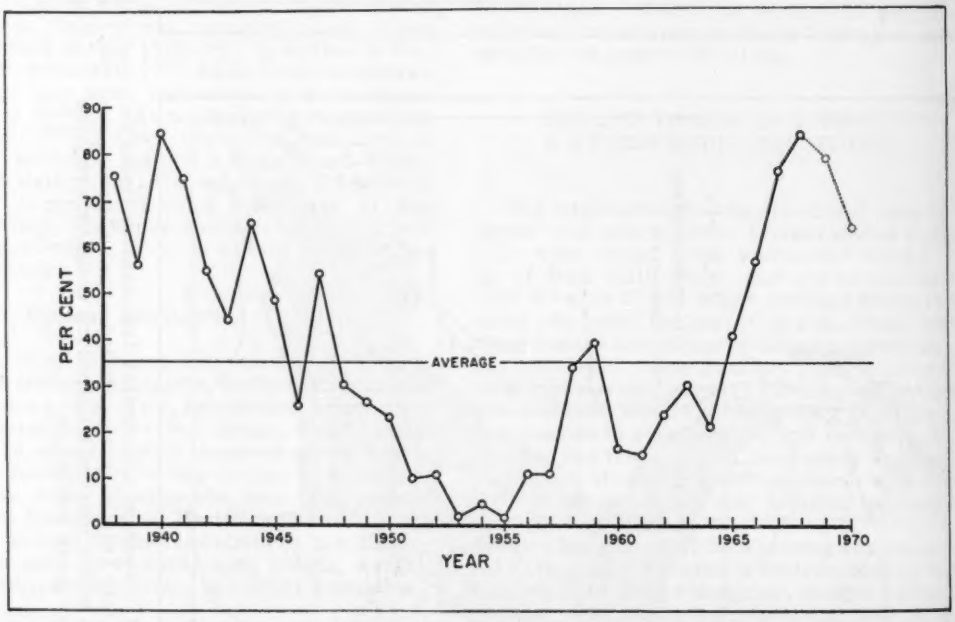


Fig. 4 - Percent of west coast albacore tuna catch taken north of San Francisco, 1938-1970.

HISTORICAL TRENDS IN CATCHES

Figures 3 and 4 give historical perspective to the albacore fishery. Figure 3 shows total landings of albacore tuna for west coast (U.S. and Canada) for 1938-70. Excluding 1938-41, the graph shows no significant trends in total landings. However, a decrease in year-to-year variability is evident in the later years. This graph does not reveal the effects of changes in fishing effort, availability, or fishing technology. In the last few years the catch has risen--but not in proportion to increase in effort and technology.

West coast landings for 1970 albacore season were 57.5 million pounds, higher than 1969 total (50.5 million pounds) and 1960-69 average (45.7). Probably, the higher 1970 landings reflect partly the increased fishing effort; although exact figures are not available, more boats fished albacore in 1970 than in 1969. At the same time, several jig-fishermen indicated their 1970 total catch was down 5 to 20% from 1969. More fishing effort is expected this year.

Figure 4 shows percentage of total catch north of San Francisco for 1938-70. The percentage north-south distribution of catch reflects large shifts in center of albacore fishery over past 30 years. An interesting and important aspect of the changes in percent distributions is that, year to year, these are small relative to long-term trends. The average year-to-year change is 13%; the largest year-to-year change is 27%.

BLUEFIN TUNA

In 1970, California bluefin landings were about 4,800 tons. These were the lowest in 17 years. In 1969, about 7,600 tons were landed. Average annual landings for 1957-68 are 10,900 tons; these include the record 17,400 tons of 1966.

ADVISORY OPERATIONS FOR 1971 SEASON

NMFS La Jolla will issue albacore advisory information throughout the season. The information will include sea-surface temperature charts, narrative albacore fish bulletins, and daily broadcasts of albacore fishing information over marine radio bands.

The Fishery-Oceanography Center at La Jolla will accept collect calls from fishermen at sea to report oceanographic, weather, and fishing information.

The telephone number is (714) 453-2820.

For more information about NMFS Albacore Advisory Information, contact:

Director
National Marine Fisheries Service
Fishery-Oceanography Center
P.O. Box 271
La Jolla, California 92037

COMMERCIAL FISHERMAN'S DIRECTORY AVAILABLE

A useful pocket-sized handbook for fishermen working off Pacific Northwest, the "Commercial Fisherman's Directory of Emergency Service," is available. It lists fish buyers and canners, medical facilities, motor and general boat repair companies, marine supply units, marine service stations, etc., for ports from Eureka, California, and north. It is a publication of the Pacific Sea Grant Advisory Program. It can be obtained free from: H.M. Dail, University of California Cooperative Extension, 1422 South 10th Street, Richmond, Calif. 94804.

THE FISHERMAN AND THE METRIC SYSTEM

The U.S. is the only major nation without plans to convert to the metric system. But it is being studied. In August 1968, Congress ordered the Bureau of Standards to study the system and make recommendations by August 1971.

Actually, the metric system has been legal in the U.S. for 105 years. Scientists, pharmacists, and others have long used the system. Many U.S. farm exports are sold by the metric ton (2,205 pounds) instead of the 2,000 pounds in the common weight. Some persons are advocating adoption of the metric system.

The Fisherman's Attitude?

Ernest D. McRae Jr., NMFS Woods Hole (Mass.) Exploratory Fishing and Gear Research Base, estimates it would take 10 to 40 years for fishermen to change from English pound system to French metric system.

Dr. J. Perry Lane, supervisory research food technologist, NMFS Gloucester, says average age of fishermen in Massachusetts area is 55 years. Change would come slowly.

The fisherman's charts list water depths in fathoms (6 feet); he hears that seas are running so many feet in wave height; visibility at sea is recorded in miles; wind speed comes in miles or knots per hour; his net's mesh size is measured in inches and his catch in pounds (especially in New England) or in tons (tuna).

Translating English into French may challenge Gloucester's school kids, who learn about the metric system, but observers are reluctant to predict that the average fisherman would embrace it warmly.

TAX REGULATION BENEFITS COMMERCIAL FISHERMEN

On June 9, the Internal Revenue Service and NOAA announced that those who lease commercial fishing vessels--and deposit money in a fund to buy, build, or rebuild such vessels--may file amended income-tax returns for 1970 if the money they deposit in the fund came from 1970 earnings.

Under a 1970 amendment to the Merchant Marine Act, eligible fishermen can agree with Department of Commerce to make such deposits. The law allows such taxpayers to reduce taxable income derived from operation of vessels covered under agreements by amounts of deposits.

How It Works

Even if a qualified taxpayer has not made such deposits, and his 1970 tax return has been filed, he may still enter into an agreement. Then he may file an amended return for a refund based on deposits into the fund.

To qualify, the taxpayer must act before Jan. 1, 1972, or within 60 days after final regulations are published, if this date is earlier. Deposits must be made within 60 days after agreement is executed.

To take advantage of new regulation, write to Director, National Marine Fisheries Service, Interior Bldg., Washington, D.C. 20235, for information.

BOSTON TO HOST FISH EXPO '71

Fish Expo '71, the 5th Annual American Fish Exposition, will be held at the Haynes Civic Auditorium, Boston, Mass., Wednesday through Saturday, Oct. 20-23, 1971.

The first expo of its kind in the U.S. was held in Boston during October 1967. Fish Expo '70 was held in Tampa, Fla., in October. Fishery industrial exhibits were displayed by organizations from 31 states and 9 foreign nations.

Information may be obtained from Fish Expo Headquarters, 3 School St., Boston, Mass. 02108.

NMFS HELPS GLOUCESTER FISHERMAN SWITCH FROM TRAWLING TO CLAM DIGGING

For about 40 years, Sam Favaloro, a ground fisherman in Gloucester, Mass., dragged for cod, whiting, haddock, and flounder. His father and grandfathers had fished before him. In recent years, it had become harder for Sam to make a living.

His attitude was reported by the New England Marine Resources Program:

"Faced with unreasonable competitive factors stemming from overfishing, foreign imports, fluctuating prices, foreign fishing boats poaching nearby fishing grounds, Sam came to realize that he would be unable to obtain an adequate living from the sea for his family of seven. His discouragement reached a high point last summer and fall when, after chasing for whiting, he returned to a seaport already overstocked with imports from South Africa and Argentina."

At that point, Sam was encouraged by scientists of the NMFS Gloucester laboratory. They urged him to investigate the ocean quahog (Artica islandica) as a developing resource for year-round fishing. The very abundant quahog is a potential substitute for the popular but disappearing surf and hardshell clams. (See CFR, April 1971, p. 17.)

Back to Learning

Sam spent November and December 1970 learning about and digging for the "ocean" or "mahogany". Convinced that a potential market existed, he was the first to register his boat with NMFS for experimental research. On Jan. 4, 1971, he applied for a $5,100 grant to Economic Development Administration (EDA) in Washington, D.C., to prove that the close-at-hand quahog could keep fishermen in Gloucester. In late March, EDA approved grant. Contract signing by Sam, EDA, and NMFS would follow.

The Operation

There will be two 2-week expeditions. Sam and 2 helpers will dredge off Massachusetts under the NMFS flag. The NMFS Woods Hole Exploratory Fishing & Gear Research Base will outfit Sam's shrimp boat (a 50-footer with western rig). Ernest D. McRae Jr., assistant base director, reported that Sam will have latest experimental gear, including hydraulic dredge, air compressor to blow the water hose, and a 30-inch dredge pump and diesel. Sam will supply the boat, some rigging and a heavy mast, well-stayed with a fixed boom.

All data will become NMFS property.

On one trip, Sam will use only a "dry" dredge. Fishermen call this a "rocking chair". It is the one most commonly seen on small boats off New England. This mechanical dredge is small, box-shaped, and steel-slatted with steel teeth for digging into the mud as dredge is towed across ocean bottom. There are 8 to 24 teeth, depending on size of the dredge towed behind boat. It is brought in over the stern by booms and winches. McRae said one big drawback of the dry dredge is that clams often are broken and the meats are easily damaged.

Second Expedition

The second expedition's hydraulic dredge uses jets of water to loosen bottom sediments ahead of digging blade. The water jets create turbulence on the ocean bottom. This exposes clams in path of the blade that scoops clams into attached steel net. The jet hits the ocean bottom about 3 to 4 feet ahead of the blade. Water is supplied to the jets through a 6-inch hose attached to a powerful salt-water pump on deck.

The 40-inch-wide digging blade at mouth of dredge can be adjusted to various digging depths. An inclined rack passes shellfish into the dredge. Two steel frames or cages form bulk of the dredge and support the jet manifold, cutting blade, and mesh bag usually made of 3-inch metal rings or links. The cage slides along bottom on broad flat runners dragging the 8- to 12-foot bag.

McRae said a 40- or 48-inch dredge needs 1,600 to 1,800 gallons of water per minute--at about 60-pounds-per-square-inch differential pressure between inside of manifold and outside water pressure, regardless of depth. Normally, the dredge is towed against tide along bottom for 5 to 15 minutes, depending on density of clam bed. Towing speed varies from 4 to 6 knots per hour.

A hydraulic jet dredge alongside commercial vessel before being taken aboard for dumping. Catch has nearly filled chain bag.

The 1,000-pound dredge is lowered by the main winch and a $\frac{5}{8}$-inch wire cable attached to a ring on forward cage towing bar. After cage is filled, the dredge is raised to surface. A line is attached to a chain bridle on rear cage. This line is used to raise rear end of dredge above deck so it can be dumped.

Can Be Operated Easily

McRae said this type of hydraulic dredge is commonly used by fishermen to harvest clams and quahogs. He added: "The hydraulic dredge can be operated quite easily from small draggers or other small fishing vessels, although this method of dredging requires more accessory gear and is more expensive than a dry dredge."

McRae reported that his unit's latest modification in the hydraulic dredge method was getting rid of the diesel pump-and-hose arrangement. This was replaced with an electrically driven submersible pump mounted on a special steel plate. The plate is located across forward end of dredge under towing bar and braces. The 8-inch pump discharge is connected directly to manifold with a reducing elbow and a short length of 6-inch hose; this acts as precaution against shock and vibration. A neoprene-jacketed cable supplies power to pump. It is handled on a powered reel that can be mounted anywhere aboard ship. Although total cost of submersible pumping system is higher, the efficiencies are greater, McRae noted.

Another Modification

Another future modification eliminates mesh bag and enlarges after-cage. Now, clams are dumped onto a sorting table equipped with running water. Fishermen stand and sort, an onerous and leg-punishing job, which is going out, says McRae.

He would like to see a constant return system. Using this, the catch is brought onto deck without hauling in the dredge. Also, he would like to see a complete preprocessing system on board ship. He noted that Soviets and others now operate such "factory" ships. These are equipped with preprocessing apparatus and refrigeration. "So this concept is certainly not new."

Ocean quahogs seem safe from Soviet exploitation because Soviets are bound by law not to dredge ocean bottoms.

McRae was optimistic about this: "Beds of clams that occur outside the contiguous fishing zone (3-mile limit) would probably be reserved for the American fisherman because the clams live within the bottom instead of over the bottom as do fish."

U.S. TO HOLD UP DISCHARGES INTO L. MICHIGAN UNDER 1910 STATUTE

Early in June, the Environmental Protection Agency (EPA) revealed that it would heed a relatively unknown 1910 Federal law and not grant permission to 7 heavy-industry firms to discharge waste into the southern end of Lake Michigan.

Chicago conservationist groups hailed EPA's decision. One of these groups, Businessmen for the Public Interest, had discovered the old law and informed EPA.

Refuse Act of 1899

EPA had planned to grant new permits for discharges into L. Michigan under Refuse Act of 1899. This act requires permission from U.S. Army Corps of Engineers, with EPA approval, before anything more can be dumped into navigable waters or their tributaries.

Earlier in 1971, Pres. Nixon had ordered a review of all existing permits. He directed EPA to renew these only if industry wastes had been purified enough to meet existing state and U.S. water-quality standards.

But the conservationist group argued that today's standards were much too low to prevent industrial discharges from seriously damaging lake. It maintained that permits that meet only present standards were only "licenses to pollute."

1910 Statute

The 1910 statute has been enacted specifically to protect southern end of L. Michigan. It banned discharge of any refuse from points along shore of Cook and Lake Counties--unless discharge is contained behind breakwater. No U.S. officer may authorize dumping contrary to this law.

1910 Statute Could Set Precedent

EPA's Administrator, William D. Ruckelshaus, said that 1910 Act could set precedent affecting future 1899 Act permits throughout U.S.

The EPA decision facilitates legal actions by conservationist groups to have the courts direct Cook and Lake County industries to change their disposal systems.

Challenge EPA's 1899 Permits

Businessmen for the Public Interest has filed suit in U.S. court challenging EPA policy on 1899 permits. The group wants the court to order EPA to require applicants for permits to instal the "most modern technology available" to clean their discharges instead of just meeting present water-quality standards.

Illinois Action

The Illinois Pollution Control Board was working to adopt more stringent standards for all State waterways. It planned to single out L. Michigan for special protection through new standards.

7 Large Companies

Use of the 1910 statute affects 7 of largest industrial firms along lake's southern shore: Inland Steel, U.S. Steel, American Maize Produce, American Oil, Union Carbide, Commonwealth Edison, and Northern Indiana Public Service.

Appeal to Atomic Energy Commission

The Businessmen for the Public Interest called on Dr. Glenn T. Seaborg, Atomic Energy Commission chairman, to ban new construction permits for nuclear power plants. It asked too that he close 11 of those already operating in U.S. until new emergency cooling systems have been designed.

The conservationist group reminded Dr. Seaborg that AEC's own studies showed present emergency cooling systems might not prevent catastrophic atomic discharge if break occurred in a reactor's normal cooling system.

U.S. & CANADA AGREE TO END GREAT LAKES POLLUTION BY 1975

Meeting in Washington on June 10, the U.S. and Canada agreed on a common program to end Great Lakes water pollution by 1975.

The $2-billion program's object is to produce over the next 4 years waters "clean enough for any fish to live in."

Unprecedented Scope

Russell E. Train, chairman of Environmental Protection Agency, described agreement as "historic first." He stated that its provisions were "unprecedented in scope" and could be model for international agreements everywhere.

Canada's Sharp

Mitchell Sharp, Canada's External Affairs Minister and a former fishery minister, noted that agreement was the "most far-reaching ever signed by 2 countries in environmental field."

Sharp had pointed out earlier that Great Lakes pollution had reached level where "two of the richest societies on earth are knowingly and wantonly poisoning this unique resource, and by extension, each other."

18-point Communiqué

At end of meeting, an 18-point communiqué announced U.S. & Canada would set up and carry out "common water quality standards" for Great Lakes and St. Lawrence River.

They agreed to conclude before end of 1971 an executive agreement on water-quality control to embrace these programs:

- Build treatment facilities for municipal and industrial wastes and animal husbandry operations.
- Reduce phosphorus discharges.
- Eliminate mercury and other toxic heavy metals from discharges.
- Control thermal, radioactive waste, and pesticide pollution.

The Cost

Implementing these controls is expected to cost U.S. about $2 billion over next 4 years--half paid by U.S., the rest by State and local governments.

Sharp said he did not know exact cost to Canada, but that it would run to "hundreds of millions of dollars." Canadian share is far less because industrial development on north shore of lakes is less advanced.

Combat Oil Spills

U.S. & Canada will coordinate steps to combat oil spills in Great Lakes. A joint response center will be activated when major spills occur.

The 2 countries will adopt compatible rules for ship designs and construction to prevent spills.

International Joint Commission

U.S. & Canada will enlarge authority of International Joint Commission. This body was set up under 1909 treaty. It has been studying for 6 years pollution problems in Lake Erie, Lake Ontario, and parts of the St. Lawrence that forms international boundary.

1970 U.S.-CANADA GREAT LAKES COMMERCIAL FISHERY FELL 10%

In 1970, the Great Lakes catch by commercial fishermen of the U.S. and Canada was 110.5 million pounds worth $11.7 million--a drop of 10.5% in weight and about 3% in value.

U.S. landings rose from 67 million pounds in 1969 to 70.4 million in 1970, but the increase was due principally to a larger alewife harvest in Lake Michigan. Last year, production in lakes Erie, Huron and Superior dropped to record lows.

The Canadian decline from an all-time high of 56.5 million pounds in 1969 to about 40.1 million in 1970 was caused primarily by a sharp drop in catch of yellow perch and smelt in Lake Erie. These two species were a little under 80% of total Canadian Great Lakes catch in 1969 and 73% in 1970. Another factor was the ban on commercial fishing in Lake St. Clair (permitted only in Canadian waters) in early April 1970 following discovery of substantial mercury contamination.

The 1970 data come from National Marine Fisheries Service office in Ann Arbor, Mich., and from preliminary statistics of Ontario Department of Lands and Forests.

The catch in waters of the Great Lakes states in 1970 was (in 000s of pounds):

Illinois	405.2	New York	533.6
Indiana	334.6	Ohio	8,420.0
Michigan	21,168.8*	Pennsylvania	505.5
Minnesota	1,306.5	Wisconsin	37,714.8*

*Alewives: Michigan 5,981.4; Wisconsin 27,478.7.

LAKE MICHIGAN

The lake's share of U.S. Great Lakes fishery production was 75% of 1970 total. Due to major role of low-value alewife--used for fish meal, oil, and pet food--the lake's share of catch value for all U.S. waters was 60%.

The 33.5 million pounds of alewives in 1970 was second only to 1967 record of 41.9 million pounds; in 1970, alewife was 48% of U.S. Great Lakes catch.

Lake Michigan also provides a large share of U.S. production of chubs and lake whitefish, the most valuable commercial species in U.S. section of Great Lakes. In 1970, the 9.6 million pounds of chubs and 1.7 million pounds of lake whitefish were 21% of total lake catch; their landed value of $2.7 million was 71% of receipts for all species. The whitefish catch was highest for lake since early 1950s.

Lake trout, the high-value species nearly eliminated by sea lamprey, provided a commercial catch of over 87,000 pounds in 1970, the greatest since restocking of this species began in Lake Michigan in 1965.

The coho salmon, first planted in Lake Michigan in 1966, has won an important place in lake's commercial and sport fishery. In 1970, the coho available to commercial outlets reached a record 2.2 million pounds. To a large degree, the fish marketed are bought from surplus stocks taken by Michigan's fishery agency during heavy fall spawning runs. This procedure permits use of huge number

of coho that cannot be taken by any sporting method--and would otherwise die in the streams after spawning.

	1969	1970	1969	1970
	(000 lbs.)		(000 $)	
U.S. total	66,968	70,389	5,968	6,338
Lake Ontario	294	333	44	79
Lake Erie	11,050	9,546	1,428	1,265
Lake Huron	2,897	2,411	493	404
Lake Michigan	47,489	53,091	3,028	3,819
Lake Superior	5,239	5,009	975	771
Canadian total	56,496	40,131	6,128	5,391
Lake Ontario	2,270	2,905	330	429
Lake Erie	48,026	31,722	4,244	3,769
Lake St. Clair	919	87	332	41
Lake Huron	2,329	2,120	819	734
Lake Superior	2,951	3,297	403	418
U.S.-Canada total	123,464	110,520	12,096	11,729

LAKE ERIE

Although Canadian landings dropped one third from 1969 to 1970, the 31.7 million pounds in 1970 were 77% of lake total. In 1969, the Canadian share was 81%. U.S. 1970 production for the 4 states bordering Erie was a new low of 9.5 million pounds, less than half the catch in 1961 and 1962.

In Canadian catch, yellow perch and smelt are dominant species--together 93% of 1970 Erie total. For yellow perch, a strong 1965 year-class was prime factor in 1969 record catch. But hatches after that have been weak to fair. So fade-out of 1965 class was reflected in 1970 landings. The high Canadian smelt catch of 1969 was dominated by a large 1967 hatch, which has not been repeated.

LAKE HURON

Commercial 1970 landings by U.S. and Canadian fishermen--about 4.5 million pounds--hit an all-time low. The downward trend results from the decline of several species. However, the Canadian catch of lake whitefish gained a fraction and reached nearly a million pounds, highest since 1960.

	Pounds				Dollar Value			
	1969 (000s)	% of Total	1970 (000s)	% of Total	1969 (000s)	% of Total	1970 (000s)	% of Total
U.S. total	66,968	100	70,389	100	$5,968	100	$6,338	100
10-species	63,513	95	66,927	95	5,156	86	5,621	89
Alewives	29,248	44	33,461	48	332	6	381	6
Chubs	10,156	15	10,934	16	1,550	26	1,842	29
Carp	6,507	10	6,582	9	266	4	397	6
Yellow perch	4,905	7	4,271	6	677	13	761	12
Smelt	3,614	5	3,555	5	116	2	96	2
Whitefish	2,323	3	2,352	3	1,412	24	1,331	21
Coho salmon	1,144	2	2,243	3	39	1	315	5
Lake herring	2,321	3	1,364	2	296	5	170	3
White bass	1,221	2	1,103	2	365	6	275	4
Sheepshead	2,074	3	1,060	1	103	2	53	1
Canadian total	56,496	100	40,131	100	$6,128	100	$5,390	100
5-species total	50,205	89	35,463	88	4,776	78	4,795	89
Yellow perch	30,468	54	21,241	53	3,313	54	3,419	63
Smelt	15,226	27	9,571	24	561	9	437	8
Lake herring	2,453	4	2,857	7	195	3	232	4
Whitefish	1,142	2	1,233	3	621	10	639	12
Carp	916	2	561	1	86	1	69	1

LAKE SUPERIOR

The 1970 catch was 8.3 million pounds, only slightly above 1969's 8.2 million, lowest figure since 1900. The 1970 catch was a record low for U.S. waters. The major factor in Superior's decline has been the sharp drop in U.S. landings of lake herring. The annual catch has decreased steadily from about 11.5 million pounds in 1961 to about 1.3 million in 1970. Smelt production in U.S. waters was 1.6 million pounds in 1970. For first time, it became leading species in Superior catch.

LAKE ONTARIO

Commercial landings in 1970 were 3.2 million pounds, the greatest since 1941 (3.7 million). The major part of lake's catch is taken in Canadian waters. A prime factor in 1970's gain here was the increase in yellow perch landings; the 1970 figure of nearly a million pounds were more than double 1969's. This gain was stimulated partly by a rise in sale price, which spurred fishing effort.

LAKE ST. CLAIR

Commercial fishing is limited to Canadian waters. In recent years, the annual catch has ranged from about 800,000 to 1 million pounds. However, in 1970, the discovery of mercury in St. Clair waters closed fishery early in the year; production was only 87,000 pounds.

OCEANOGRAPHY

NAVAL OCEANOGRAPHIC OFFICE CUTS GUESSWORK IN SEDIMENT STUDIES

The U.S. Naval Oceanographic Office (NOO) has eliminated much guesswork in investigating sediment deposits in harbor and coastal areas by using a special survey instrument. This was reported by Captain F. L. Slattery, NOO Commander.

The device is a high-resolution, high-frequency seismic profiler. It has been used successfully aboard small survey craft to measure the thickness and extent of subsurface layers.

How It Works

The instrument, said Newell Stiles, who directed the trials, generates continuous wave fronts on frequencies of 5 and 12 kilohertz. It records the time required for the sound pulse to travel through the water and the sediment cover. It plots these travel times automatically to produce cross-sectional outlines. These are coordinated with precise positioning data to make contoured maps.

Stiles noted: "As the wave fronts encounter materials of contrasting acoustic impedance (in the sediment cover), portions of the transmitted sound are returned, in the form of echoes, to the (water's) surface where they are sensed by the profiler's transducer. The materials of contrasting acoustic impedance are normally manifestations of geologic stratification or boundaries."

Contoured Maps Made Quickly

He said contoured maps showing thickness of muds and clays between the boundaries can be constructed easily in the field. The maps can be forwarded immediately to ocean scientists studying sediment cover.

The maps can eliminate the need to initiate tight survey patterns, the present method for adequately charting sediment deposits.

WATER-CIRCULATION STUDIES AID POLLUTION CONTROL

NOAA is conducting a detailed 2-year study of the dynamics of water circulation in Boston Harbor and Massachusetts Bay. It is part of a larger NOAA program of similar studies in coastal and estuarine waters.

The survey will provide necessary data for pollution-control authorities to maintain and preserve the marine environment. The latest information on current speed and direction in the Boston Harbor area also will contribute to navigation safety.

NOAA's National Ocean Survey's 'Ferrel' is being used.

Ferrel's Gear

The Ferrel's primary means of observing currents is the TICUS (Tidal Current Survey). The system, which is being used extensively in the program, employs current meters suspended from buoys at preselected stations throughout the Boston Harbor area. Observations of the current's speed and direction at various depths at each station are recorded for study by the National Ocean Survey at Rockville, Md.

Also, scientists are using a photographic recording current meter to record on 16 mm film the current's speed and direction. Other instruments include sensors for observing water temperature, salinity, and depth.

The survey results will appear in two National Ocean Survey publications.

NOAA has scheduled circulation studies of the entire coastal area from southern Maine to Rhode Island during the next 3 to 5 years.

NOAA SUPPORTS SALT-MARSH RESEARCH IN GEORGIA

NOAA has awarded a $216,700 Sea Grant to the University of Georgia to study the use and conservation of salt-marsh estuaries in Georgia. Part of the program will be conducted by the Skidaway Institute of Oceanography at Savannah.

There is a real need for salt-marsh ecological and utilization studies. For about a hundred years, the Georgia coastal region, except around Savannah and Brunswick, has had a low population and very little development. As the timber-and-plantation economy diminished, then died, many sea islands returned to a wild state.

A Period of Change

The status of the coastal region has been changing rapidly in recent years. Certain sea islands have been bought by or donated to the U.S. or Georgia. Planning for other islands and close-in areas includes resort development, strip-mining sites, and mariculture. A nuclear power plant is being built. Coastline and estuarine development is gathering momentum--yet there is little information on the effects changes might have on organisms and other resources within the marshes.

What Scientists Will Study

Scientists will investigate the natural and biological factors affecting growth and reproduction of marsh organisms, and the economic potential of salt marshes. Diseases that affect man's use of estuarine species will be studied. The scientists will monitor 4 finfish and 4 shellfish species and examine them for pathogenic microorganisms and parasites.

Using existing findings by NMFS and fishermen, the researchers will try to increase fishery production. They will focus on abundant fish species off Georgia that are not being fully used.

SATELLITES MEASURE SEA-SURFACE TEMPERATURE IN U.S.-MEXICO SURVEY

The results of a U.S.-Mexican oceanographic survey, LITTLE WINDOW II, are expected to tell scientists how accurately two meteorological satellites--NOAA I and ITOS I--can measure changes in the ocean's surface temperature and monitor the weather. This was reported by Rear Admiral W.W. Behrens Jr., Oceanographer of the Navy.

LITTLE WINDOW II was an oceanographic survey of a 100 by 100 mile square in the Gulf of California. It tested the ability of infrared sensors aboard the NOAA and ITOS satellites to measure the ocean's surface temperature from space.

U.S.-Mexico Survey

LITTLE WINDOW II was larger than a survey in the same area in March 1970. During early May 1971, U.S. and Mexican scientists used 3 specially equipped research aircraft and 5 survey vessels to run oceanographic transects of the window region. The temperature information will be compared with infrared readings collected simultaneously by the satellites during their twice-daily passage over the area.

Participating in this cooperative venture were Mexico's Navy and Instituto Nacional de Pesca; the Inter-American Tropical Tuna Commission; and FAO.

The U.S. Naval Oceanographic Office (NOO) coordinated LITTLE WINDOW II. Cooperating were NOAA's National Marine Fisheries Service, National Environmental Satellite Service, National Weather Service, and National Oceanographic Data Center; NASA and its Ames Research Center; and Scripps Institution of Oceanography.

Gulf of California Unique

NOO says the Gulf of California is uniquely suited for this type of experiment. It has an extremely dry atmosphere with a minimum of clouds, land masses distinctive enough to position spacecraft results within desired oceanographic tolerances, and a fairly uniform sea-surface temperature.

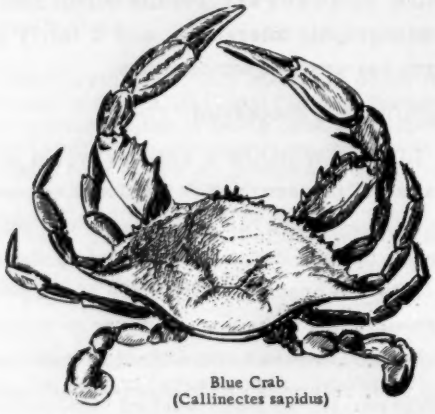
Significant If Successful

LITTLE WINDOW's success would show that satellites can provide continual sea-surface temperature for any ocean. Such information would be very helpful: to fishery scientist to predict distribution of temperature-oriented fish, such as tuna; to meteorlogist, who studies warm and cold ocean fronts and their relationships to short-period meteorological changes and seeks reliable long-range weather forecasts; to oceanographer searching for a quick way to look at temperature conditions over broad sea surfaces. The meteorological and water-mass condition implications are especially interesting to the Navy.

CHESAPEAKE BAY HARD CRABS WILL BE SCARCE THIS SUMMER

Hard crabs will be scarce in the Chesapeake Bay until August, say scientists of the Virginia Institute of Marine Science (VIMS), Gloucester Point, Va. They conduct regular surveys of blue-crab stocks. They predict the crab-pot and trotline catch this summer will be 8 to 10 million pounds, near the lowest since 1960.

The average catch from June through August over the past 11 years was 16 million pounds. The average was exceeded in 7 of the 11 years; in 4 years, the catch was below average. The largest landings, in 1967, totaled almost 22 million pounds; the smallest was 8.5 million pounds in 1969.



Blue Crab
(Callinectes sapidus)

Present Crabs Hatched in 1969

The crop of commercial-sized crabs now available was hatched in 1969. Routine surveys of some Virginia rivers revealed few small crabs in fall 1969. The crop failure was believed caused by heavy rains during August 1969. Low supplies of the 1969 hatch were reported by VIMS in spring 1970 and again in the fall. The summer scarcity was expected.

The scientists add an optimistic note: there should be many soft crabs and peelers this summer, possibly more than at any time during the last 10 years. These crabs, hatched in 1970, will produce the bulk of the commercial hard-crab catch from September 1971 through August 1972.

VIMS STUDIES INCREASING PRODUCTION OF SOFT BLUE CRABS

A NOAA Sea Grant is enabling scientists of the Virginia Institute of Marine Science (VIMS), Gloucester Point, Va., to study methods of increasing soft blue-crab production in the Chesapeake Bay.

Soft crabs for food and peeler crabs for fishing bait have high public demand--but are only a small part of total blue-crab landings in Chesapeake Bay.

The 10-Year Record

During the past 10 years, an annual average of 3.5 million pounds of soft and peeler crabs were produced worth $1.2 million. Although these landings were less than 5% of the bay catch of crabs, they earned 20% of the dollars.

Records show fluctuations in hard and soft crab production, says Paul A. Haefner Jr., marine scientist in VIMS Crustaceology Department. The dollar value of hard crabs remains fairly constant; that of soft crabs varies according to number produced. Although dollar value of hard crab fishery exceeds that of soft crab, the latter is worth more per pound.

Haefner noted that if more soft and peeler crabs were taken, there would be fewer crabs to become mature hard crabs--but income from soft crabs would increase without changing markedly the value of hard crabs.

Adequate supplies of peeler crabs are available for harvesting. What has kept production of soft crabs at low levels has been absence of guidelines for efficient construction and maintenance of holding facilities.

Sea Grant Project's Aims

Haefner said the primary aim of the VIMS Sea Grant project is development of plans for physical plants for shedding crabs in tanks with open-flow or recirculated sea water. The scientists also will establish guidelines for acceptable levels of water quality, and for the condition and quantity of crabs that can be handled. Another project aspect is the study of crab mortality and, perhaps, ways to prevent this loss to industry.

HARD CLAM CLEANSING IN NEW YORK

Robert B. Mac Millan and James H. Redman

The State of New York (NY) has approximately 400,000 acres of underwater marine lands suitable for the cultivation of shellfish. Thirteen percent of this area is closed to the harvesting and marketing of shellfish due to microbial pollution. Many of these areas, including Jamaica Bay, Raritan Bay, Manhasset Bay, Hempstead Harbor and portions of Long Island Sound lying within Westchester County, support abundant populations of hard clams (Mercenaria mercenaria). These shellfish constitute a natural resource which is not being utilized and a public health menace if harvested and marketed illegally.

Interest and concern have been expressed by Federal and state regulatory agencies and members of the shellfish industry to exploit these areas. As a result, the N.Y. Department of Environmental Conservation initiated a transplant program in 1964: shellfish were removed from closed areas and placed in certified waters for a minimum of 30 days to achieve purification. An alternate process known as depuration offers purification under more stringent controls. Although the general concept of this process is not new, only limited laboratory data have been accumulated relative to the effectiveness of this process in cleansing hard clams.

New York initiated a study in 1964 to gather data for proper evaluation of a hard-clam commercial depuration plant operation. Following the preliminary investigations, funding was obtained in 1965 from the Bureau of Commercial Fisheries (BCF) under Public Law 88-309 to conduct a pilot-plant study of the depuration of hard clams.

Pilot Plant for Hard-Clam Depuration

The depuration plant has four essential components, including controlled dry storage for untreated and treated shellfish; depuration tanks; and sea-water treatment. Office and laboratory facilities are optional depending on a particular situation. A typical plant layout is shown in Figure 1.

The pilot plant was located on the Great South Bay at West Sayville. Great South Bay is located on the south shore of Long Island (Figure 2) and is a highly productive area with 1969 commercial landings of 6,280 million pounds of hard clams valued at $6,850,000. This site had been used in the initial 1964 studies. However, several modifications had to be completed prior to the operation of the plant.

A boiler-burner combination and heat exchanger were installed with the assumption that raw sea water taken from the bay would require a significant amount of heating for winter operations. The hard clam ceases to feed with water temperatures below 45 degrees Fahrenheit (^{o}F). The recommended water temperature for the depuration process is 59^{o} F. Since the water temperature for Great South Bay approaches 30^{o} F. during the winter months, a 29^{o} F. increase would be required prior to use in the system.

The clam holding tanks were redesigned and rebuilt to improve the flow of water through the system. Three tanks, each 9.1 feet long, 9.7 feet wide, and 1.375 feet deep, were built with sea water entering each tank at the rate of 20 gallons per minute (GPM).

Two settling tanks also were built adjacent to the holding tanks. Initial plans were prepared on the premise that sea water for the system would be drawn from Great South Bay. Since this water normally contains high levels of suspended particulate matter, the settling tanks were planned to remove this material prior to passage through the heat exchanger and sea-water sterilization units.

Mr. Mac Millan is Assistant Sanitary Engineer and Mr. Redman Senior Aquatic Biologist (Marine), N.Y. State Department of Environmental Conservation, Division of Marine and Coastal Resources, 4175 Veterans Memorial Highway, Ronkonkoma, N.Y. 11779. The study was conducted in cooperation with the Department of Commerce, National Oceanic and Atmospheric Administration, National Marine Fisheries Service under Public Law 88-309, Project 3-68-D. Contribution No. 71-3, Division of Marine and Coastal Resources.

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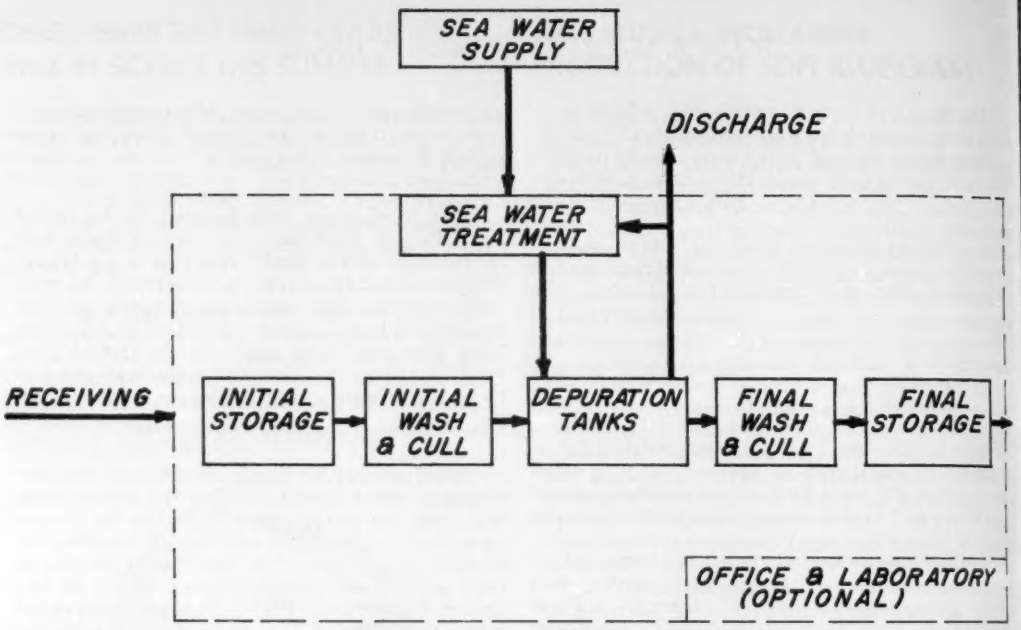

Fig. 1 - Schematic diagram of a depuration plant.

A sea-water well was installed as a supplementary water supply for the operation of the plant. Figure 3 shows the plant arrangement used throughout the test program.

Sea-Water Well System

Four experimental wells were driven. Each consisted of a 12-inch slotted point coupled to 5-foot lengths of 1.25-inch galvanized pipe. At each well site, water samples were collected at 5-foot intervals and analyzed for salinity and temperature.

Following the completion of each well, a centrifugal pump was connected to the system and operated for approximately 1 hour to determine flow characteristics and water quality at each site. A brief summary of the average data obtained at the four sites follows.

Summary of Experimental Well Point Data	
Pumping Rate	- 30 GPM.
Water Temperature	- 54.5 - 55.5° F.
Salinity	- 24.0 - 25.5 parts per thousand (°/oo).
Bacteria/milliliter (ml)	- None readily detectable.
NOTE: These data are summarized from a well point depth range of 20 to 50 feet below tidal water level.	

As a result of these data, a 4-inch-diameter well was installed in the plant adjacent to the settling tanks. This system included a 4-inch-diameter stainless steel intake screen, 10 feet in length, coupled to 35 feet of 4-inch-diameter steel well casing.

The pumping rate for this system of approximately 225 GPM was reduced by inserting a 2.5-inch diameter polyvinyl chloride (PVC) pipe inside the steel well casing and perforating the lower 6 inches of this pipe with 0.25-inch diameter holes. The flow rate was further controlled by the addition of a 2.5-inch diameter ball valve located on the discharge side of the pump. The final installation is shown in Figure 4.

The well proved to be extremely effective and offered several important advantages when compared to drawing sea water from Great South Bay. The advantages include:

1. Constant salinity.
2. Constant temperature year round.
3. Elimination of heating requirements for the water.

Fig. 2 - Location of New York State Depuration Plant and areas where hard clams were harvested.

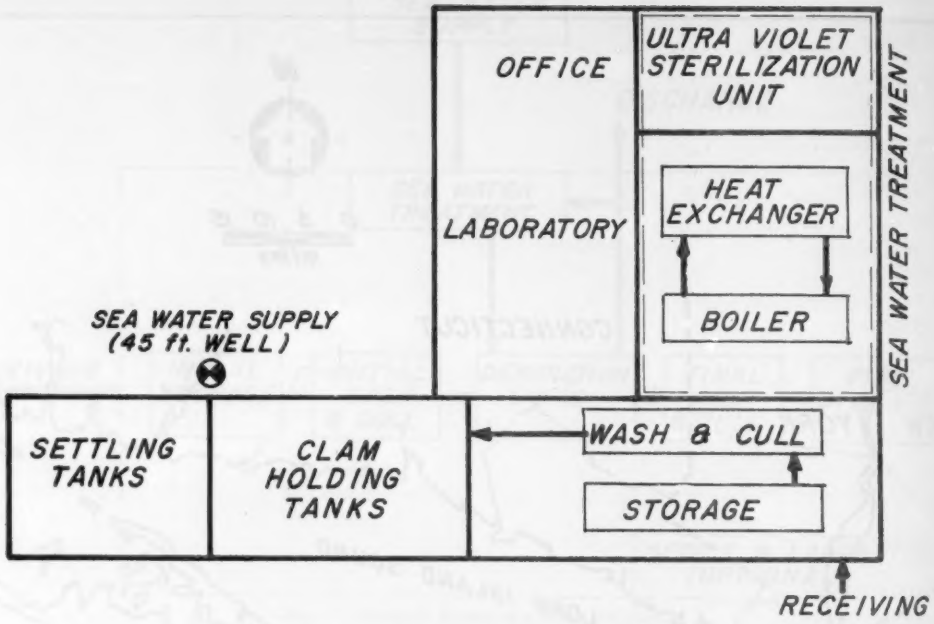

Fig. 3 - Layout of the New York State Depuration Plant.

4. A minimum amount of ultra-violet sterilization since the well water is practically free of detectable bacteria.

5. Elimination of fouling organisms and growth within the sea water distribution lines because these organisms are removed by natural sand filtration.

6. Elimination or reduction of settling tanks since no suspended matter is present.

Operation of the Depuration Plant

Following the completion of modifications on the depuration plant, a series of 42 experiments was conducted. Lot sizes varied from 5 to 45 bushels of hard clams per experiment, depending upon the availability of clams.

Hard clams for the experiments were obtained from several growing areas, including portions of Flanders Bay, Jamaica Bay, Raritan Bay, Hempstead Harbor, and portions of Long Island Sound lying within Westchester County.

The initial step in the pilot-plant operation required a prewash and cull of the clams before loading them into baskets. This operation is necessary to remove foreign matter attached to the shellfish that might impair water quality in the holding tanks. The operation was performed using a mechanical clam washer similar to that designed by the State of Maine for use in the soft clam (Mya arenaria) industry. The washer consists of a chain link conveyor belt and a series of spray nozzles to remove mud or other matter that might be attached to the shellfish. Following a high pressure spray, injured shellfish and other debris are removed from the belt. It should be noted that the design of this particular washer must be modified for use with the hard clam. The hopper portion of the washer uses an inclined plane, which is too steep for hard clams (see Figure 5).

After the prewash, the clams were loaded in baskets 20 inches long, 18 inches wide, and 6 inches deep. The baskets were made of wire coated with plastic (PVC) and held one-half bushel when filled to a depth of 3 inches. The shellfish were placed in the shellfish holding

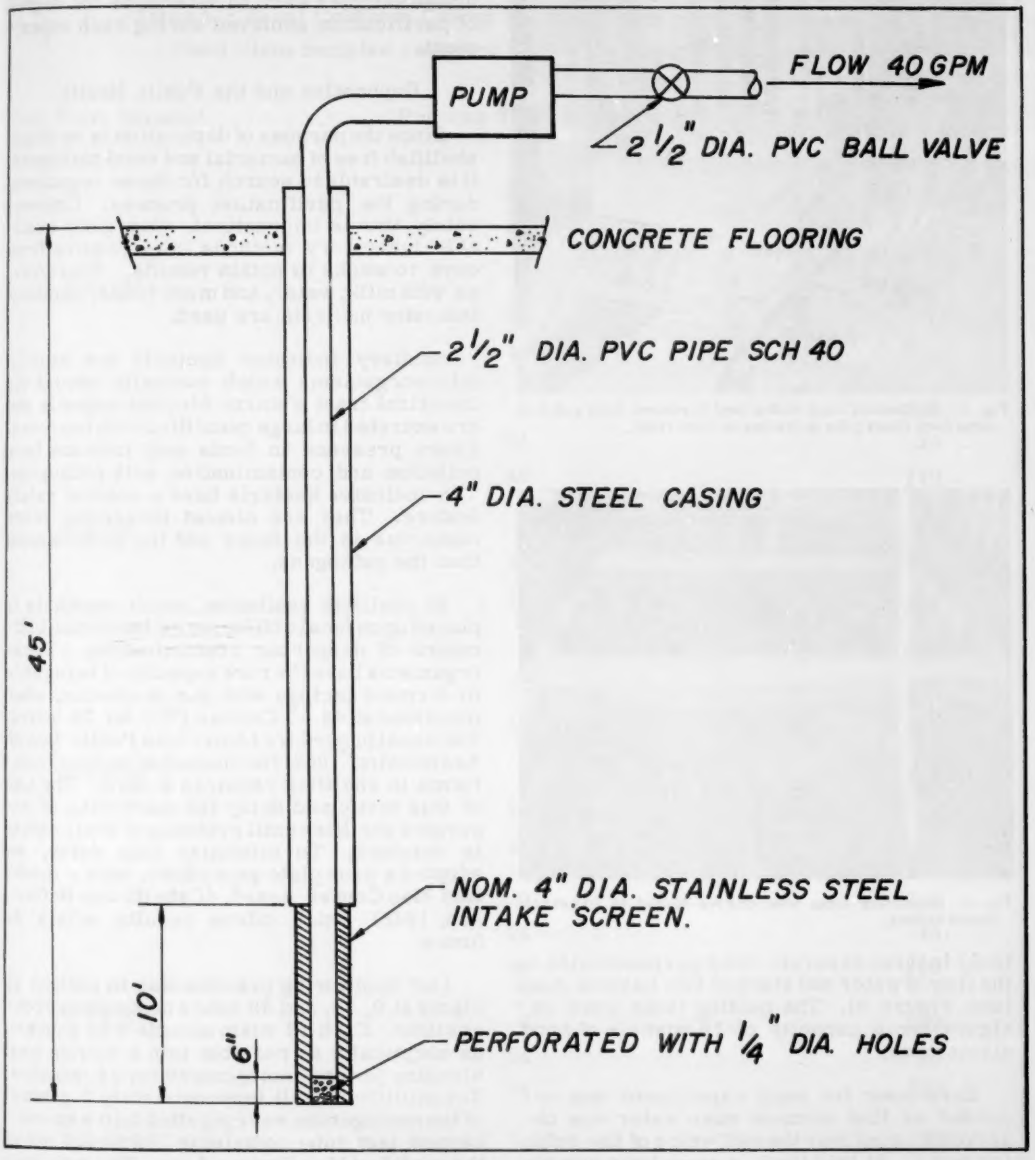

Fig. 4 - The sea water well system.

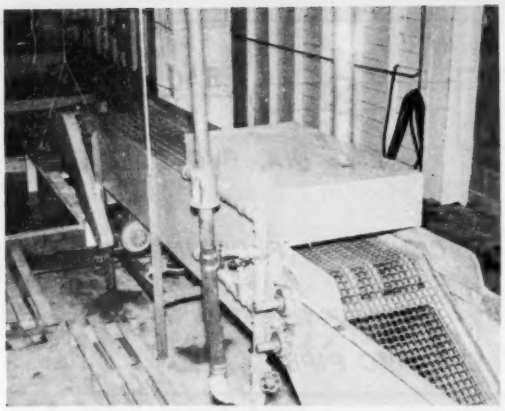

Fig. 5 - Mechanical clam washer used to remove muds and detritus from clams prior to loading in clam tanks.

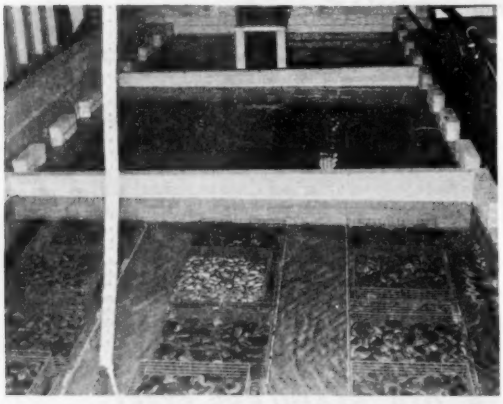

Fig. 6 - Depuration tanks with clams loaded in plastic coated baskets.

tanks in three separate rows perpendicular to the flow of water and stacked two baskets deep (see Figure 6). The holding tanks were designed for a capacity of 15 bushels of hard clams each.

Zero hour for each experiment was recorded as that moment when water was observed flowing over the exit weirs of the holding tanks. At this time, a zero-hour sample of clams was collected for bacteriological examination. A second sample was collected at 24 hours and a final sample at 48 hours. These samples were to determine the degree of purification achieved during each experiment.

Depuration and the Public Health

Since the purpose of depuration is to obtain shellfish free of bacterial and viral pathogens, it is desirable to search for these organisms during the purification process. Unfortunately, this is impractical. Currently available laboratory methods may require from days to weeks to obtain results. Therefore, as with milk, water, and most foods, sanitary indicator bacteria are used.

Sanitary indicator bacteria are usually microorganisms which normally inhabit the intestinal tract of warm-blooded animals and are excreted in large quantities with the feces. There presence in foods may indicate fecal pollution and contamination with pathogens. The indicator bacteria have a notable safety feature. They are almost invariably more numerous in the feces and the environment than the pathogens.

In shellfish sanitation, much emphasis is placed upon fecal coliforms as bacterial indicators of dangerous contamination. These organisms have the rare capacity of being able to ferment lactose with gas production when incubated at 44.5° Celsius (°C) for 24 hours. The usual procedure (American Public Health Association, 1962) for enumerating fecal coliforms in shellfish requires 3 days. The use of this test could delay the marketing of depurated shellfish until evidence of their safety is obtained. To minimize this delay, we adopted a pour plate procedure, with a modified Mac Conkey Agar[1], (Cabelli and Heffernan, 1966) which offers results within 24 hours.

Our monitoring practice was to collect 12 clams at 0, 24, and 48 hours depuration process time. Each 12-clam sample was shucked as aseptically as possible into a sterile food blending jar and homogenized for 1½ minutes. Ten milliliters (ml) (approximately 5 grams) of the homogenate were pipetted into a screw-capped test tube containing 100 to 120 ml of the modified Mac Conkey Agar. The tube was gently inverted several times to insure adequate mixing and the contents distributed among 6 Petri plates which were incubated in

[1]Ingredients, modified Mac Conkey Agar: Gelysate, 17.000g; Polypeptone, 3.000g; Lactose, 10.000g; Bile Salts #3, 0.750g; Agar, 13.500g; Neutral Red, 0.30g; Crystal Violet, 0.001g; Sodium Chloride, 5.000g; Distilled Water, 1000ml.

Table 1 - Fecal Coliform Colony Forming Units per 100 grams for Hard Clam Samples collected during the Depuration Process

Date Trial Initiated	Process Time In Hours	Fecal Coliform CFU/100 g.
7-9-68	0	1000
	24	120
	48	20
7-15-68	0	2500
	24	/20
	48	/20
7-22-68	0	320
	24	20
	48	/20
8-6-68	0	5100
	24	100
	48	/20
8-6-68	0	200
	24	/20
	48	/20
8-13-68	0	180
	24	20
	48	/20
9-11-68	0	460
	24	40
	48	/20
9-18-68	0	200
	24	20
	48	/20
9-25-68	0	140
	24	20
	48	/20

CFU = COLONY FORMING UNITS.

an air incubator at 45° C. for 24 hours. Fecal coliform colonies[2] were totaled for the six plates, multiplied by 20, and reported as Fecal Coliform Colony Forming Units per 100 grams of sample. Results of 9 hard clam depuration trials are included in Table 1.

Bacterial monitoring of hard clam depuration is most successful during the warm months. Hard clams harvested in December, January, February, and March are practically free of fecal coliforms, regardless of the water quality of the growing area.

When sea-water temperatures fall below a certain value, the clams cease feeding and accumulating bacteria. We have, however, observed that a structure called the crystalline style is absent from winter-harvested hard clams but may be detected when the clams are exposed to sufficiently warmed water. The crystalline style is a semitransparent, cone-shaped organ found in the vicinity of the stomach.

Several winter trials were conducted to determine the value of the crystalline style as a measure of hard clam activity during the depuration process. Results of these trials are detailed in Table 2. They indicate that, while all clams lacked a style initially, the structure was visible in 50% to 92% of the clams after exposure to the purification process.

Table 2 - Development of a Crystalline Style in winter harvested Hard Clams Subjected to the Depuration Process

Date Trial Initiated	Depuration Process Time in Hours	No. of Clams Examined	No. of Clams Possessing a Crystalline Style
1-7-69	0	24	0
	24	24	18
	48	24	22
1-14-69	0	24	0
	24	24	19
	48	24	16
1-21-69	0	24	0
	24	24	17
	48	24	19
1-23-69	0	24	0
	24	24	22
	48	24	16
3-18-69	0	100	0
	24	100	90
	48	100	92

[2]Red or Pink Colonies $\frac{1}{2}$mm. or more in diameter usually surrounded by a zone of precipitated bile salts.

Summary and Conclusions

The term "depuration", as related to shellfish and the shellfish industry, involves a process whereby shellfish harvested from certain restricted areas are placed in a controlled environment for a specified period of time in order to remove any bacterial or viral contamination that may be present. These shellfish may then be placed on the market for human consumption.

A program to evaluate the feasibility of depurating hard clams, utilizing a pilot-plant operation, has been completed by the State of New York. Hard clams were harvested by commercial methods from closed growing areas and subjected to a 48-hour process using sea water obtained from a well system. Shellfish samples were analyzed at 0, 24, and 48 hours to evaluate the effectiveness of the depuration process.

An analysis of the data gathered during this study indicated that the depuration process may use hard clam resources in restricted waters. The term "restricted waters" is defined in Part I, National Shellfish Sanitation Program Manual of Operations, as waters where the coliform median MPN does not exceed 700 per 100 ml.--and not more than 10% of the samples exceed an MPN of 2,300 per 100 ml. Furthermore, the area may not be so contaminated with radio-nuclide or industrial wastes that consumption of the shellfish located therein might be hazardous. As this definition implies, the depuration process is used only to remove bacterial and/or viral contamination. Contaminates such as heavy metals, pesticides, and radionuclides are not eliminated in the 48- or 72-hour process time.

The sea-water supply for the depuration process is of vital importance. The use of the salt-water well system in this program proved to be extremely effective; it is recommended that this source be considered and used, if available, at future depuration sites.

Data are presented for depuration trials conducted during the summer and winter seasons. The presence of the crystalline style does indicate hard-clam activity during the winter season, although the enumeration of a microbial indicator during this season would be more satisfactory in evaluating the process's effectiveness.

The program was terminated in 1969. An analysis of the data indicates that the depuration process may be used to cleanse hard clams taken from restricted waters. As a result, New York will authorize use of this process by private concerns. Specific growing area locations and plant designs will be considered and reviewed on an individual basis. New York will also provide laboratory support to ensure proper operation of the plant.

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DISEASE IN THE LIVES OF FISH
The Role of Pollution Is Now Being Assessed

Richard Wolke

Ichthyopathology, or the study of fish diseases, is a discipline that bears out the prophetic words of Rudolf Virchow, who said in the late 1800's, "Between animal and human medicine there is no dividing line. . ." Although still in its infancy, the discipline is rapidly awakening the interest of such diverse investigators as the comparative pathologist, the cancer researcher and the ecologist. This interest was reflected in the establishment last year of a small diagnostic and research histopathology laboratory at the University of Rhode Island where fish tissues are examined microscopically for evidence of disease.

The sudden popularity of the field can certainly be attributed in part to the world's rapid increase in population, which has called upon all scientists to find new means of resource conservation and to feed this growing mass of humanity. But the primary stimulus for its new popularity can be attributed to two groups until recently rather widely separated in their interests--the aquaculturists and the comparative pathologists.

Aquaculturists Concerned

Aquaculture has been an important and integral part of agriculture for many centuries, especially in such countries as China and Japan, where fish make up a good proportion of the daily diet. As in any intensive livestock operation, be it with birds or mammals, the bringing together of large numbers of animals in a confined area lends itself to the rapid spread of disease processes. Aquaculture is not immune to this phenomenon. So it was the aquaculturist who first began to ask pertinent questions about fish mortality, and it was the aquaculturist who first began the study of fish diseases.

As the field of human medicine became more sophisticated, it became apparent that diseases of lower vertebrates, long studied by veterinarians, could add much to the body of knowledge collected by the physician. The words of Virchow, who is considered the father of modern pathology, were indeed prophetic. The veterinary pathologist was in a position to supply the physician with animal models of human diseases. It was only a question of time before these veterinarians began to see the importance of fish diseases and to study these diseases in an attempt to help both the physician and the aquaculturist.

Do Fish Suffer Disease?

For the uninitiated, the field of ichthyopathology may raise a number of questions. For instance, do any fish diseases of consequence in fact exist? Are diseases responsible for some of the mass mortalities--fish kills--we occasionally read about in our newspapers? Do they have an effect upon population dynamics or fluctuations of fish in the wild? Are they involved in mortalities connected with aquaculture projects? The answer to all of the questions is yes. Disease plays an important role in the life of all species of fish.

In fact, our investigations indicate that fish suffer from much the same kinds of diseases as man and the other higher vertebrates. Fish contract viral, bacterial and fungal diseases. They, like man, are neither immune to diabetes nor leukemia. Some of their diseases reach epidemic proportions and are responsible for mass mortalities of natural populations. One of the most important killers of fresh-water fish is the bacteria Aeromonas liquifaciens, an ubiquitous organism which, under the right environmental conditions, may increase rapidly in numbers and virulence. Marine fish, too, are no exception to epidemic disease processes. A case in point is the 1933 mass mortality of herring in New Brunswick due to the fungus Icthyophonus hoferii.

At present we are unable to state positively what proportion of fish kills are due solely to disease. We are unable to do so because so few kills are examined by competent pathologists. Qualified investigators are not often called to the scene of the kill and, if

Dr. Wolke is Assistant Professor of Animal Pathology, University of Rhode Island. His essay appeared in 'Rhode Island Resources' April 1971.

objective investigations are made, they are usually concerned only with water quality. If the water meets approved standards, the cause of mortality usually goes undetermined.

Pollution Kills Many Fish

There can be little question that present day pollution of our streams and rivers is responsible for many mass kills of freshwater fish. Pollutants that affect acidity, alkalinity or dissolved oxygen, or which increase the heavy metal content of the water may be responsible for sudden kills of massive numbers of fish and other aquatic fauna.

Dr. Wolke examining a lesion, or abnormal change within tissue, in a filet of an ocean pout. About 25 years ago these lesions caused the disappearance of ocean pout from the fresh fish market for esthetic reasons. There is no reason to believe the disease is communicable to man.

Of interest to the pathologist, however, is the relationship between low levels of pollution and disease processes. There is much evidence in the literature that this relationship is synergistic, meaning that the combined effect of these factors may be more devastating than any of them acting alone. For instance, the added stress of lowered oxygen tension may increase the risk of fish contracting various infectious bacterial diseases. Other controlled experiments have shown a higher incidence of disease in fish exposed to low levels of insecticides.

Poor Year-Class

In some instances, heavy infestations with intermediate (developing) stages of tapeworm parasites, while not responsible for mass mortality, may be responsible for sterility, leading to poor year class production and definite effects on population dynamics. The best example of this disease type is the freshwater bass tapeworm, Proteocephalus ambloplitus. The bass normally harbors the adult worm in its intestines with no ill effects. However, in areas of dense tapeworm populations, the bass may serve as its own intermediate host and be infected by the larval or plerocercoid stage of the worm. Under these circumstances, the plerocercoid may take up residence in the ovary, resulting in destruction to potential and actual ova.

Diseases of Wild Populations

If the diseases of wild populations of fish were surveyed by randomly sampling them throughout the year, a broad spectrum of diseases would be found, caused by a number of agents. Most commonly, the lesions observed may be classified histopathologically, but will be of unknown origin. This is a reflection on the serious lack of knowledge in the field of ichthyopathology and can be overcome only by patient observations and descriptions. The comparative pathologist must collect base data in order to become aware of the many diseases that certainly exist in the fish, but are presently unknown.

In such a survey, the majority of known lesions will probably be due to the larval stages of migrating worms of the helminth parasite group. This is not to say that parasites are responsible for killing large numbers of fish, for it is indeed a poor parasite that kills its host. There can be little question, however, that such larval migrations are

responsible for decreasing the efficiency of organs infected. In those isolated instances where overwhelming infections do occur, they are responsible for fatalities.

Probably the second most important causative agent recorded would be protozoa (one-celled animals). Fish suffer from a wide number of protozoa, which are both internal and external parasites. This is not surprising, because their aquatic environment is ideal for the reproduction and passage of such organisms. The survey would also include bacterial and fungal diseases, instances of disturbed metabolism, congenital anomalies and, on rare occasions, tumorous processes. It is an unfortunate fact that such a survey would miss many of the older, diseased and weakened fish because of the nature of this environment, where predators and scavengers are quick to dispatch the slow and unhealthy specimens.

Fish Diseases in Aquaculture

It is, however, under aquaculture conditions that we see the most striking examples of fish diseases. In warm, fresh water culture, protozoan external parasites such as Ichthyophthrius multifilis, Chilodenella sp. and Trichodina sp. are responsible for large losses of fish. Bacteria, especially Aeromonas sp. are also serious pathogens. In cold, fresh water husbandry of salmon and trout, a number of viral diseases have been described such as infectious pancreatic necrosis, Egvedt disease and infectious hematopoietic necrosis. Bacterial agents responsible for heavy mortalities have also been incriminated in salmon and trout production. These include the causative agents of furunculosis, Aeromonas salmoncida and Cytophaga psycrophilia, the probable cause of 'cold water disease.' In addition, aquaculture projects are not free of nutritional imbalances or of toxins introduced with the feed, such as aflatoxin, which proved responsible for hepatomas in trout.

Methods for the farming of marine fish (maraculture) are now being seriously explored. Here, too, agents responsible for disease are being regularly recovered. They are the same kinds of etiologic agents we face in fresh water environments, but are adapted to higher salinities.

It is not enough, however, for the aquaculturist simply to know what kind of disease his fish have contracted. If he is to be a successful producer, he must be able to prevent and cure these diseases. Much research is presently being done in the field of therapeusis. We know that many fish pathogens are susceptible to antibiotics commonly used in human and veterinary medicine. Nonetheless, problems arise in dosage rates, means of efficient administration and in treatment of viral and parasitic diseases that are resistant to antibiotics.

Immunizing Agents

One of the most exciting areas of therapeusis is production of biologicals or immunizing agents. It has been known for some time that higher fish are capable of producing antibodies. But only recently has it been shown that these antibodies are able to protect fish against diseases. One major problem is the temperature-dependent nature of the antibody-producing mechanisms of the fish. That is to say, below 50 degrees Fahrenheit antibody production essentially ceases, so that diseases contracted at low temperatures may be resistant to active immunization. The ideal situation would be the development of an oral immunizing agent that could simply be added to tank or pond water to produce a solid and long lasting immune response.

Fortunately the fish, like higher vertebrates, has natural protective mechanisms against many of its diseases. Inflammation is, in fact, the body's response to invading organisms. The inflammatory response of fish is quite similar to the inflammatory response of man and other mammals. The fish is capable of "walling off" a TB nodule or producing cells capable of ingesting and destroying invading bacteria, so that in the wild the disease is not always successful. It is these very inflammatory responses so important to the health of the fish that are also of such vital interest to the comparative pathologist in his study of human and animal diseases.

Fish Diseases Spread to Humans?

An area as yet unstudied is the relation of fish diseases to human health. A disease transmissible from animal to man is known as a zoonose. We are aware of a few zoonoses of fish origin such as the broad tapeworm of man Dibothociphalus, and the bacteria Erysipelas sp. Work in 1968 by investigators

studying fish in Chesapeake Bay indicated that fish close to densely populated areas of human habitation had antibodies against a number of human pathogens. The exact significance of this work has not been determined, but it is indicative that fish may serve as monitors of human disease organisms and therefore may be of public health significance. Recent work by this author (1970) indicates that striped bass, white perch and mummichogs carry a psittacoid agent, which is a microscopic organism similar in some respects to both virus and bacteria. It is similar in appearance to the agent responsible for parrot fever in man. However, interest in the public health aspects of fish diseases has been limited and they must be more intensively investigated.

Diagnostic & Research Lab

The diagnostic and research histopathology laboratory for the study of fish diseases was set up at the University of Rhode Island through the cooperation of the College of Resource Development and the Graduate School of Oceanography, with financial assistance from the Sea Grant program of the National Oceanic and Atmospheric Administration. This laboratory offers diagnostic services to aquaculturists throughout New England. Diseases under investigation include, 'cold water disease' of salmon, Plistophora infections of ocean pout and psittacoid infections of marine fish. By means of a continuing survey of marine fish, both normal and abnormal tissue sections are being collected, classified and stored to serve as base data for teaching and future research projects. The laboratory is also working in conjunction with the International Congress Against Cancer in an attempt to recover and classify neoplastic processes of bottom feeding fish.

TAIWAN'S USE OF FISHERY RESOURCES

Yung C. Shang

The fishing industry is among Taiwan's most vital assets. Exploitation of fishery resources has grown rapidly during the past decade. The annual average production growth rate is about 11.6%. This article examines the industry's place in Taiwan's economy, development trends, and the major factors that may account for the industry's rapid growth.

Fisheries in Taiwan's Economy

Fish production affects income, foreign markets, employment, and food intake.

In 1969, fishery landings increased to a record 560,918 metric tons worth about $146 million--about 3.07% of the Gross National Product. Between 1960 and 1969, catch and value more than doubled.

In 1969, fish exports were more than 146 times those of 1960. They totaled 101,284 metric tons valued at $44.7 million and produced a favorable balance of trade of marine products of about $38 million. The larger the export surplus, the more foreign exchange is available to purchase capital goods necessary for fishery development. Moreover, the expansion of fish markets, both internal and external, is a powerful income generator that stimulates the growth of supplementary industries. In 1969, some of those to benefit were: 60 ship building and repair yards, 417 fish-processing plants, 341 ice-making plants, and 275 cold-storage and freezing plants.

Fishing operations provide many jobs. In 1969, nearly 286,404 people were fully or partly employed, about 6% of all workers. Moreover, the fisheries are an alternative livelihood for the farm population living in and around coastal villages.

The increase in fish production also assures Taiwanese of an adequate supply of an important source of nutrition. The Food Balance Sheet of 1962-1968 shows that fish consumption accounts for about 55% of animal protein intake.

Development Trends

There are four classifications of fisheries in Taiwan: deep-sea, inshore, coastal, and culture. These classifications differ primarily in the relative distance from shore of the fishing areas, and in craft and gear used. Deep-sea fisheries use powered vessels of 50 or more tons and operate as far out as the Southwest Pacific, the Indian, and Atlantic Oceans. Inshore operations use primarily medium and small powered craft usually within 30 nautical miles of shore. Sampans and bamboo rafts--the working fleet of coastal fisheries--operate along shores and on rivers and lakes. Fish culture concentrates on the resources to be found in brackish and freshwater ponds, shallow water, and paddy fields.

Decade of Progress

Between 1960 and 1969, the total catch more than doubled (Table 1). Intensified exploitation of deep-sea and inshore fisheries accounted for the large increase. Deep-sea and inshore fishery production increased 199% and 134%, respectively, between 1960 and 1969; production of these two fisheries was about 85% of the total 1969 production compared with 70% in 1969. The relative importance of coastal fisheries is declining because of the limited fish resources in inner coastal areas and increased competition from the rapid expansion of deep-sea and inshore fisheries.

Table 2 indicates that the number of fishermen declined between 1960 and 1969 primarily because of the mechanization of fishing operations. However, the number of full-time fishermen shows no significant change. This implies that the number of part-time fishermen decreased. The expanding powered fleet has permitted the transfer of many part-time fishermen to full-time status.

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TABLE 1

ANNUAL FISHERIES PRODUCTION,[a] 1960-1969
(in thousand metric tons)

Year	Total	Deep-sea Fisheries	Inshore Fisheries	Coastal Fisheries	Fish Culture
1960	259 (100)	85 (100)	95 (100)	30 (100)	49 (100)
1961	312 (121)	106 (125)	117 (123)	32 (105)	57 (117)
1962	327 (126)	114 (133)	132 (140)	32 (107)	49 (99)
1963	351 (135)	120 (141)	144 (152)	37 (123)	50 (102)
1964	376 (145)	127 (149)	161 (170)	32 (107)	56 (115)
1965	382 (147)	136 (160)	161 (170)	31 (102)	54 (110)
1966	425 (164)	169 (199)	172 (182)	25 (84)	59 (119)
1967	458 (177)	189 (222)	187 (197)	26 (88)	56 (115)
1968	531 (205)	241 (283)	208 (219)	25 (83)	57 (115)
1969	561 (217)	255 (299)	222 (234)	27 (90)	57 (116)

[a]Numbers in parentheses are indexes, 1960 = 100.

Source: Taiwan Fisheries, published by Taiwan Fisheries Bureau, 1969.

TABLE 2

INDEX OF FISHERMEN AND VESSELS, 1960-1969
(1960 = 100)

	Fishermen		Vessels			
				Powered		
	Total	Full-Time	Total Number	Number	Tonnage	Horse Power
1960	100	100	100	100	100	100
1961	97	102	98	105	107	111
1962	96	102	94	109	111	117
1963	95	103	95	117	117	126
1964	94	99	89	138	130	147
1965	88	85	88	147	150	173
1966	86	90	89	160	181	213
1967	87	94	91	174	224	283
1968	89	101	90	182	261	302
1969	90	101	97	189	294	337

Source: Derived from Fisheries Yearbook, Taiwan Area, 1969, published by Taiwan Fisheries Bureau, 1970.

Since production more than doubled between 1960 and 1969, while number of fishermen declined 10%, productivity per man increased significantly. Similarly, a decrease in total number of fishing vessels and a large increase in number of powered boats indicate the substitution of powered for nonpowered craft; also they suggest an increasing capital-labor ratio as the chief reason for increased productivity.

Examining the composition of Taiwan's fishing fleet during these years, Table 3 verifies that the change in new technology was more capital-using than capital-saving. That is, all tonnage classes of powered vessels showed increases in number except the 50-99.9 class; the largest increase was in over-100-ton class.

A sharp rise in the number of vessels over 100 tons can be explained by the high profitability of investment in large ships. This conclusion is verified by the results in Table 4 based on a sample survey in 1965 of production costs of private fishing.

There is no significant change in the average product per boat-ton for the class over 100 tons. The production cost per boat-ton, however, is much lower for boats in the large classes. In addition, the large vessels typically exploit fish of high value, which usually are exported at high prices and generate greater net profit.

Moreover, ships in fishing operations not only increased in size between 1960 and 1969, but also in power per gross tonnage (Table 2). The number of powered vessels increased 89%; gross tonnage increased 194%; and horsepower increased 237%. A more powerful engine increases the potential number of fishing trips at the margin, thereby increasing potential profit.

TABLE 3

INDEX OF POWERED FISHING VESSELS BY GROSS TONNAGE, 1960-1969

	Less than 5 tons	5-19.9 tons	20-49.9 tons	50-99.9 tons	Over 100 tons
1960	100	100	100	100	100
1961	101	110	106	99	125
1962	105	117	110	93	140
1963	111	128	100	93	153
1964	127	164	104	110	162
1965	131	186	110	84	223
1966	138	198	117	85	351
1967	144	226	133	88	477
1968	147	233	155	80	575
1969	150	228	232	78	662

Source: Derived from Fisheries Yearbook, Taiwan Area, 1969, published by Taiwan Fisheries Bureau, 1970.

TABLE 4

AVERAGE PRODUCTION AND COSTS PER BOAT TON BY VESSEL SIZE

Size Class (tons)	Average Production Per Boat Ton (M.T.)	Average Production Cost Per Boat Ton (N.T. $)[a]
50 - 100	2.5	26,000
100 - 200	3.7	23,000
200 - 500	3.5	20,000
500 - 1000	3.4	20,000

[a] New Taiwan dollars. $1 = N.T. $40.10.

Source: Report on the Sampling Survey of Production Costs of Private Fisheries in Taiwan, 1965, published by Taiwan Fisheries Bureau, 1966.

Factors Favorable for Rapid Growth

The trends of industry development have resulted in the modernization of equipment and technique. Emphasis was placed on substitution of capital for labor. This is a costly process. It cannot be accomplished on a large scale with rapid growth unless the basic resource, fish stock, is plentiful enough to justify large investment; the government is willing and able to provide technical and financial aid and to assist in research and training; the institutional structure is favorable for development; and markets, domestic and foreign, show promise for expansion.

Abundant Natural Resources: Taiwan's 1,600-Km.-long coastline and its favorable marine environment leave little doubt as to the abundance of fish resources. Deep water abutting precipitous cliffs along the Eastern Coast forms a favorite highway for migratory fish from both South and North; and a gradually inclining western shelf, abounding in biological nutrients, provides an excellent habitat for fish propagation. This convenient access to fish resources, limited arable land, and a rapidly growing population largely account for the increasing attention toward exploitation of marine resources as an important part of Taiwan's economic reconstruction.

Government Assistance: Rapid fishery growth also has benefited from an active and vital role played by the government.

The significant addition since 1960 of powered fishing boats, for example, is a direct result of a governmental plan: "Concentrative Utilization of Capital for the Exploitation of Marine Resources." By 1968, more than 100 new ocean-going fishing vessels, 150-1,500 tons, were built with government funds. According to a 5-year program launched in 1968, the projected fish catch in 1972 is 800,000 metric tons; to achieve it, $29 million will be invested in 131 new fishing boats. The loans are obtained primarily by, or through, the government from the World Bank, Asian Development Bank, American Aid funds, or authorized bank loans.

Government funding also has been important in financing technological innovations in fishing technique and equipment. During the 1940s, most fishing boats used semidiesel, electric-ignition engines; at present, nearly 80% of all powered boats are equipped with diesel engines. The substitution of electric generators for conventional batteries and the use of synthetic fiber net also have enhanced fishing efficiency. Most deep-sea fishing craft contain the most up-to-date navigation

and electrical equipment, including fish finders, direction finders, radio transmitters and receivers, line haulers, cold-storage and freezing facilities, and radar and loran.

Government services used by the fishing industry are an equally important factor in the rapid fishery growth. For example, the fishing harbor at Kao-Shiung in Southwest Taiwan has been expanded and its facilities improved by the government to accommodate 600 vessels in the 100-ton class. Radio stations have been established with government assistance to disseminate oceanographic, meteorological, biological, and marketing information. To further the development of deep-sea fishing, the government has established 50 foreign bases in the South Pacific, the Indian and Atlantic Oceans, and in the Mediterranean Sea. Fishermen using these facilities can unload and resupply locally and thereby reduce operational costs.

Government impact on fishing-industry success is noted too in recent attempts to coordinate fishing development programs with education, training, and research. At present, 3 colleges, 5 fishery vocational schools, and 3 fishery research institutes exist in Taiwan to further marine studies. The colleges emphasize navigation, marine engineering, fish processing, shipbuilding, fishing technology, and fish management. Research and experimentation in fishing techniques, fishing biology, fish preservation, exploration of fishing grounds, and collection of fishing data are carried on at fishery research institutes.

Also, the Taiwan Fisheries Bureau has conducted short-term training classes to impart fundamental knowledge and skills to potential fishermen, and to those transferring from inshore to deep-sea fishing. These courses include instruction for deep-sea long-liner skippers, deep-sea mechanical technicians, deep-sea fisheries' radio operation of new navigation and fishery apparatus. These classes have improved the productivity of the labor force and increased the supply of skilled workers for mechanized high-sea fishing.

Fishermen's Associations: The extent to which fishermen have organized to enhance their own welfare has contributed much to the success of the fishing industry.

As in agriculture, there is often a feeling that the producers of raw materials are not adequately rewarded for their labor, while wholesalers and retailers receive more than their share of profit. The fishermen's desire to increase their bargaining power has been a major factor in the formation of 68 fishermen's associations at the district/city level, and one at provincial level. These associations have influence, as can be seen in the "Regulation Governing the Wholesale Market of Agricultural Commodities in Taiwan Province." According to this law, all first-hand sales of fish must be made through a wholesale fish market near where the fish are caught; an exception is remote fishing villages, where the catch generally is sold at landing site.

Wholesale marketing is one primary function of fishermen's associations, which operate the market and provide the site and facilities. The market transaction generally is by auction, and only licensed dealers can bid. If the owner is not satisfied with the bid price, he retains the right to reject it and place his fish into cold-storage provided by the association. After the transaction, the association deducts 2.5% of sales value to cover operation, improvement of marketing facilities, and fishermen's welfare activities.

The associations are required to collect another 2.7% of sales value to cover stamp tax, business taxes, the fishermen's share of a harbor maintenance fee, and collective fishermen's insurance in contract with the Labor Insurance Bureau of the Taiwan Government. Covered by the fishermen's insurance are child birth, sickness, death, old age and disability.

The associations serve other functions. They assist fishermen in purchasing fuel and oil from government-operated Taiwan Petroleum Company; they assist fishermen in negotiations with manufacturers for the purchase of engines, fishing gear, and navigational equipment; they negotiate loans from the government and banking institutions, and re-extend at their own risk to members who cannot provide sufficient collateral to meet the requirements of banks. Bait fish is bought and sold within the association by member fishermen. In foreign purchasing, applications for import permits and foreign exchange usually are made through the associations.

The associations also are extension services through which the government can help the fishermen increase efficiency. Study groups may be set up to exchange information on fishing grounds, fishing gear, and techniques. Fishing contests, navigation safety facilities, net-treating facilities, cold-storage facilities, harbor improvements, etc., are other services contributing toward improving fishing efficiency and boosting fishery production.

Expanding Markets: Expanding foreign markets and high export profitability reflect Taiwan's growing fishing industry.

Traditionally, Japan has been the world's leading country in fish export. The competitive position of Japanese fish exports is based mainly on cost factors. Production costs (largely labor cost) of the Japanese tuna fleet have risen sharply in recent years with general rise in Japan's economy. Japan faces increasing competition from Taiwan and South Korea. The latter's lower labor costs have strengthened their competitive positions in world markets. Also, domestic consumption of tuna in Japan is rising as income rises. A larger proportion of its catches is consumed at home. Therefore, Japan, has lost part of its world market, especially U.S., to South Korea and Taiwan. Due to increased world demand for fish, the world prices of frozen tuna and shrimp have become much higher than domestic prices in Taiwan. The high profitability of tuna and shrimp export to the expanding world market contributes much to the rapid expansion of Taiwan fisheries.

A Look Ahead

Whether or not Taiwan's fisheries continue to grow rapidly in the future will depend upon their ability to adapt to changing conditions. Biological studies indicate that the potential increase in the world tuna production, excepting skipjack, is very limited. Also, fleet labor costs have risen significantly in recent years due to the rapid growth of the industrial sectors. These suggest: (1) Taiwanese fishermen, if they are to increase their share of a limited supply must rely upon superior technique and efficiency to reduce production and marketing costs; (2) Since the potential yield of albacore, yellowfin, and bluefin is limited, deep-sea fisheries development should be diversified; and (3) Attention should be directed toward exploitation of skipjack resource, which remains underexploited.

Whatever direction the industry takes, it will always have to operate under the constraint of being part of a worldwide fishing community. After all, commercial fishing is carried on primarily in international waters where producers from all countries compete for a limited, fugitive resource. The fish belongs to no one until captured. Exploitation in any region may exceed maximum sustainable level of catch. The effect is to raise the aggregate costs of fishing. This dissipates the potential economic rent through a larger effort than is necessary to catch the allowable maximum yield; it results in a loss to everyone's economic welfare. Therefore, it is desirable to encourage international cooperation and coordination of research efforts--as well as international regulatory measures to limit catch in a region to a level that would maximize the potential economic yield.

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HOW TO INSTAL AN ECHO SOUNDER IN A SMALL FIBERGLASS BOAT

Larry D. Lusz

The standard technique for installing an echo sounder on a vessel is to mount the transmitting/receiving transducer on the exterior of the hull. For large displacement vessels, this method of installation does not create many problems because the boats operate in deep water at relatively slow speed. However, the externally mounted transducer generates several problems on smaller boats. The most significant problems are the tranducer's vulnerability to damage when operating in shallow water or placing the boat on a trailer, and reduced performance of the boat hull.

In small boats, a more practical place to mount the transducer is inside the hull. Many smaller boats are constructed of reinforced fiberglass plastic; therefore it may be possible to transmit and receive acoustic signals through the hull's bottom. An internal transducer mounting would offer several advantages over external mounting by solving the abovementioned problems--and allowing easy access to the transducer for maintenance and repair. However, boat hulls with air bubbles or filler materials in the fiberglass could present a problem by reducing the echo sounder's performance.

This paper reports the results of the installation of an echo sounder in a fiberglass boat. The transducer was mounted inside the hull in a watertight well.

THE BOAT AND ECHO SOUNDER

The boat, a Thunderbird[1/] (model Iroquois), is 23 feet 9 inches long at the center line, and 8 feet wide across the beam. It has a cathedral-style hull with a small enclosed cabin forward. It is powered by an inboard/outboard drive unit with a 200-horsepower engine.

The boat is constructed from reinforced fiberglass plastic with wood structural members. The manufacturer says the hull was constructed from a combination of polyester-type resin and glass fiber that was relatively free of air bubbles and filler materials.

The echo sounder was a Ross Fineline Model No. 200 operating at a frequency of 105 kHz. Maximum range of the system was 200 fathoms. Power at 12 v. d.c. was supplied to the transmitter/receiver from the boat batteries. The readout was of the dry-paper type.

The piezoelectric transducer was constructed from barium titanate. It had a diameter of 5 inches and a length of 3 inches. The beam angle was 8 degrees.

ECHO SOUNDER INSTALLATION

A watertight well was designed for mounting the transducer inside the boat (Figure 1). Initially, the well was filled with sea water to conduct tests of sound level measurements; but oil or other viscous incompressible fluids,

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1/Trade names referred to in this publication do not imply endorsement of commercial products.

COMMERCIAL FISHERIES REVIEW
Reprint No. 909

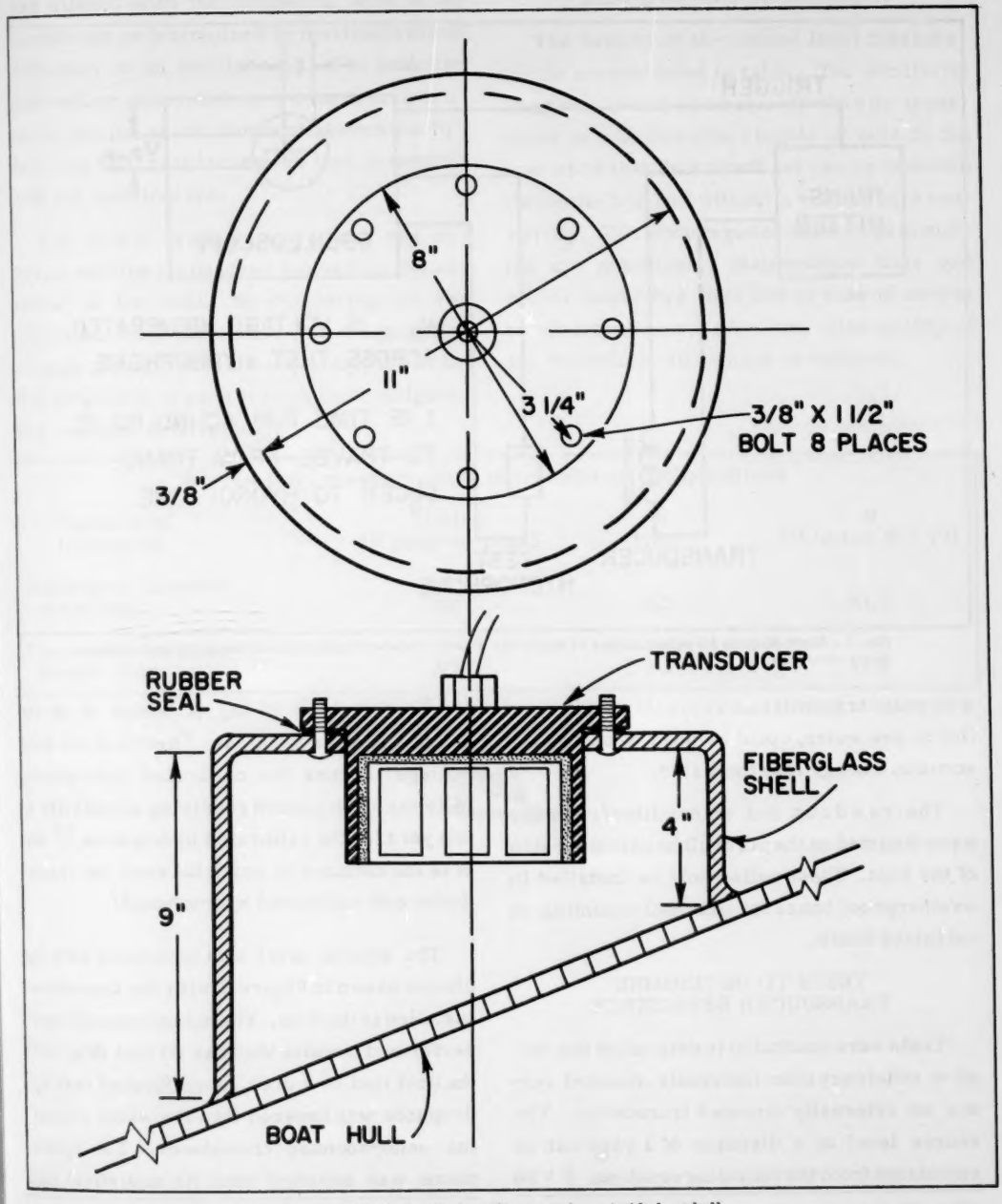

Fig. 1 - Well design for installing transducer inside boat hull.

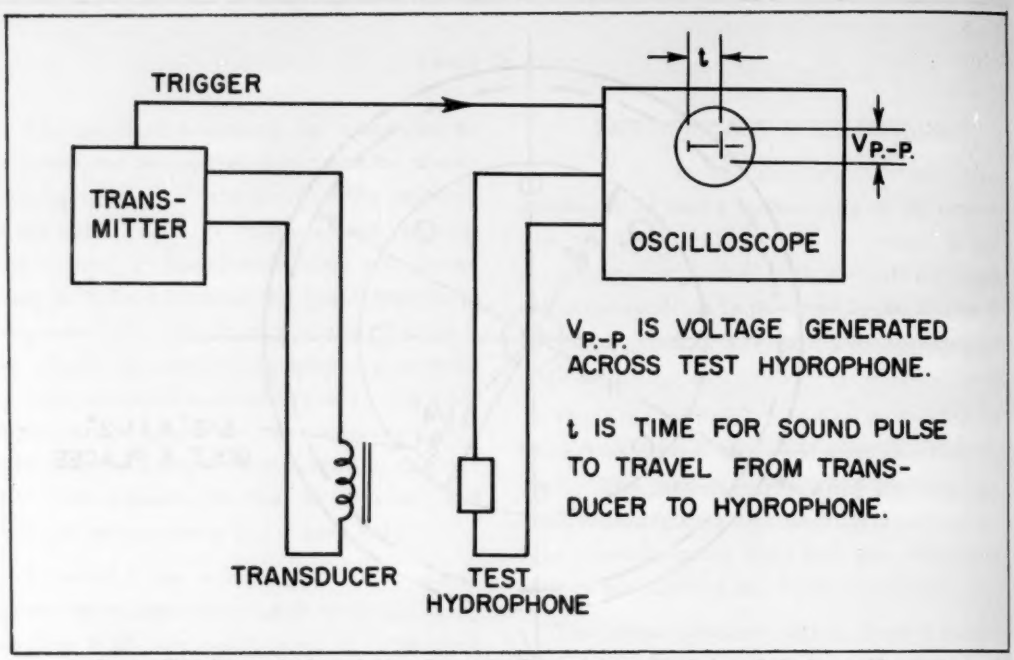

Fig. 2 - Block diagram for determination of separation distance between transducer and hydrophone and for source level measurement.

with sound transmission characteristics similar to sea water, could be used to couple the acoustic energy into the water.

The readout and transmitter/receiver were mounted on the port bulkhead in the cabin of the boat. These units could be installed in weatherproof boxes for external mounting on cabinless boats.

TESTS TO DETERMINE TRANSDUCER EFFICIENCY

Tests were conducted to determine the relative efficiency of an internally mounted versus an externally mounted transducer. The source level at a distance of 1 yard can be calculated from the following equation: $S = 20 \log V_{hydro} - M + 20 \log R$ where S is the source level in db/u bar, V_{hydro} is the rms voltage across the calibrated hydrophone, M is the open circuit receiving sensitivity at one yard for the calibrated hydrophone,[2] and R is the distance in yards between the transducer and calibrated hydrophone[3].

The source level was measured with the circuit shown in Figure 2 with the transducer installed in the boat. The measurements were performed in water that was 30 feet deep with the boat tied to a dock. A calibrated test hydrophone was lowered into the water beneath the echo-sounder transducer. The hydrophone was adjusted until its acoustical axis

2/M = -112.8 db/u bar (calibrated by Applied Physics Laboratory, University of Washington).
3/Kinsler, Lawrence E., and Austin R. Frey, "Fundamentals of Acoustics," John Wiley & Sons, Inc., New York, 1962.

was aligned with the acoustical axis of the transducer as determined by maximum signal deflection on an oscilloscope. The peak-to-peak voltage generated across the test hydrophone and the exact distance between the hydrophone and transducer were then measured with the oscilloscope.

The source level measurement was repeated with the transducer located on the exterior of the hull. By comparing the two measurements, the effect of transmitting through the hull and, subsequently, the relative efficiency of each transducer configuration could be determined.

RESULTS AND CONCLUSION

The results of the source level measurements are tabulated in table. The similarity in source level measurements when the transducer is mounted either inside or outside the boat show that the transducer can be mounted inside the boat hull without a reduction in sensitivity. The advantages of an internal mounting are significant. Maintenance time and repair costs are less due to ease of access to the transducer. Also, the vulnerability of the transducer to damage is reduced.

Source level measurements of transducer configurations

Location of transducer	V_{hydro} (V peak-to-peak)	R (yds)	S (db/u bar @ 1 yd)
Transducer mounted inside boat	.06	8.2	95.9
Transducer mounted outside boat	.07	7.9	95.6

THE SEPARATION OF CRAB MEAT FROM SHELL & TENDON BY A CENTRIFUGAL PROCESS

Wayne I. Tretsven

In a laboratory study of improved methods for removing shell fragments and tendon from hand-picked Dungeness crab meat, researchers at the Seattle Fishery Products Technology Laboratory examined the application of centrifugal force to the problem. Trials with an industrial, solid-bowl centrifuge indicated that a machine of this type had great potential for the separation of meat from shell.

The centrifuge, a Bird Machine Co.* solid-bowl machine, designed primarily for the classification and separation of materials like gravel, had a rated capacity of 0.7 cubic foot of solids per minute and required a 30 hp motor to overcome the starting inertia. The unit required 15 hp for normal operation after starting.

In these studies, the machine (Figure) was fed with chopped crab or crab shell in a saturated brine slurry. The separated meat was screened from the brine as it left the centrifuge. The brine was recirculated at rates up to 15 gallons per minute.

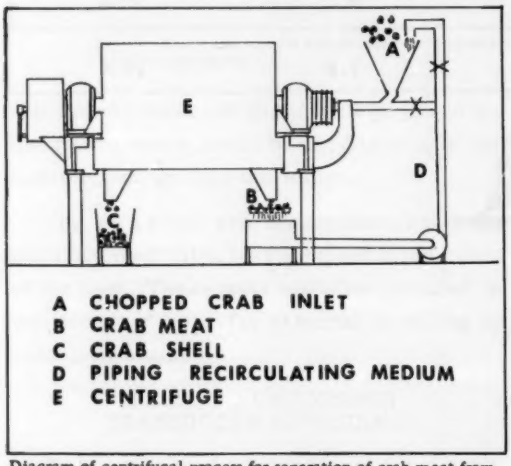

Diagram of centrifugal process for separation of crab meat from shell.

Separation of Picked Meat from Shell & Tendon

The centrifuge was first tried with fresh, commercially picked Dungeness crab meat obtained from the "shaking" table. This meat contained pieces of shell and tendon that are removed by brine flotation in normal plant practice. The material was slowly added to the hopper from which it was carried by saturated brine at approximately 12 gpm into the bowl that rotated at 2,000 rpm. Within 2 or 3 seconds, pieces of meat appeared in the effluent. Pieces of shell and tendon were thrown from the solids discharge end of the centrifuge. Little or no meat was carried over with the shell or tendon and, aside from the pieces of tendon that were attached to meat, no shell or tendon remained in the meat. If pieces of gill were mixed with the meat, they remained with the meat during centrifugation. Usually, pieces of gill are removed at the time of butchering. Although the recovered meat was shredded and excessively salty to taste, the first trials showed that it is feasible to separate crab meat from crab shell by means of a centrifuge.

Recovery of Meat from Crab Shell Scrap

Dungeness crab shell scrap (the shell remaining after the removal of meat by hand) was chopped into pieces ranging in size from about $\frac{1}{8}$ to $\frac{1}{2}$ inch and fed into the hopper in saturated brine. The centrifuge separated the slurry into meat-free shell and shell-free meat. In three different lots of scrap used, the meat recovered ranged from 14 to 20 percent of the weight of the scrap. This is roughly equal to 15 percent of the weight of the meat removed by hand picking.

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COMMERCIAL FISHERIES REVIEW
Reprint No. 910

The meat from the shell scrap was of small particle size, perhaps in part because of chopping. However, it was darker in color and flakier than the pieces of muscle described in the previous section. This meat could be valuable alone, but it appeared to us that its greatest value was as an ingredient for blending with larger, more fibrous pieces of meat for use in manufactured products such as crab cakes.

An example of recovery of meat from scrap in a "typical" Dungeness crab plant might be useful in pointing out the potential significance of this procedure. If we assume a plant with 20 pickers or shakers, each of whom produces 100 pounds of meat an hour for six hours per day, the total shell scrap produced per day is approximately 12,000 pounds. Using a realistic figure of 15 percent yield of meat from the scrap, it is clear that about 1,800 pounds of meat are recoverable. Assuming further that the quality of the recovered meat is such as to yield a return only half that of easily shaken meat, using May 1971 prices for Dungeness crab meat, the 12,000 pounds of scrap shell produced daily contains recoverable meat worth about $1,400.

Centrifugal Recovery of Edible Meat from Other Crab Species

In separate experiments, Dungeness crab body and leg sections, blue crab claws, and snow crab legs and bodies were chopped and then fed into the centrifuge in a saturated salt solution slurry. In all cases, the meat was free from shell and tendon, and the shell was free from meat. As was the case in other tests, the meat was shredded and more salty than desirable. Yield data were not obtained for Dungeness crab. Yields from blue crab claws and snow crab legs and snow crab body sections are shown in table.

Yield of meat obtained by centrifugal treatment of blue crab claws and snow crab body sections and legs

Source of meat	Yield of meat
	Percent by weight
Blue crab claws (cooked)	31
Snow crab bodies (cooked)	52
Snow crab legs (cooked)	29

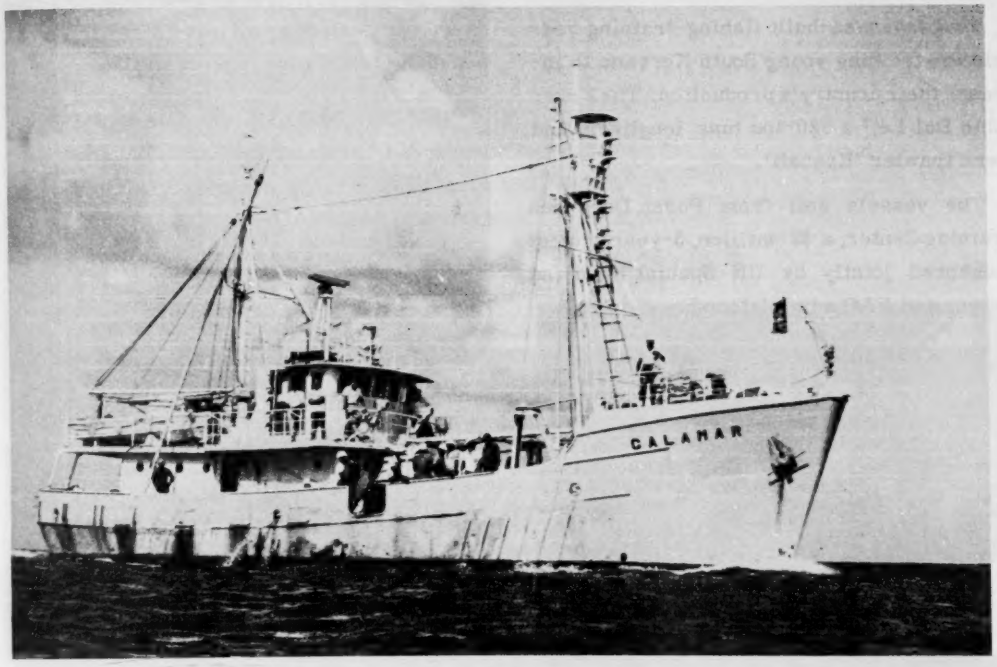
Recent Developments

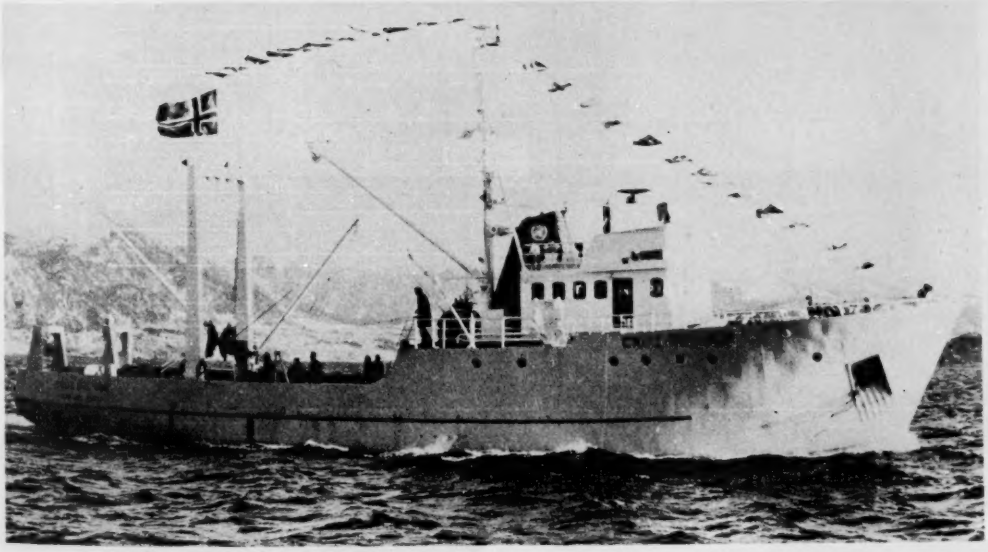
Since the completion of the work reported here, a centrifuge designed specifically for the separation of crab meat from shell and tendon has been designed and constructed. This machine is being tested at the Fishery Products Technology Laboratory at Gloucester, Massachusetts. The results of early tests are highly favorable and show that the new centrifuge produces a considerably better product than that produced by the centrifuge used for tests carried out in Seattle.

VESSELS OF FAO FLEET

Three of the nearly 100 FAO vessels searching for food the world over are pictured here. (See also CFR, April 1971.)

The 56-foot, British-built 'Fregata' is one of 3 FAO vessels to dramatically change the Caribbean fisheries. The other 2 are the 81-foot twins, 'Alcyon' and 'Calamar', built in Japan in 1966 to cross Pacific under own power. (FAO photos)





Since its 1968 launching, the 102-foot 'Cruz Del Sur' has set fishing records, reports Argentina. The vessel operates from Mar del Plata as a combination stern trawler and purse seiner.

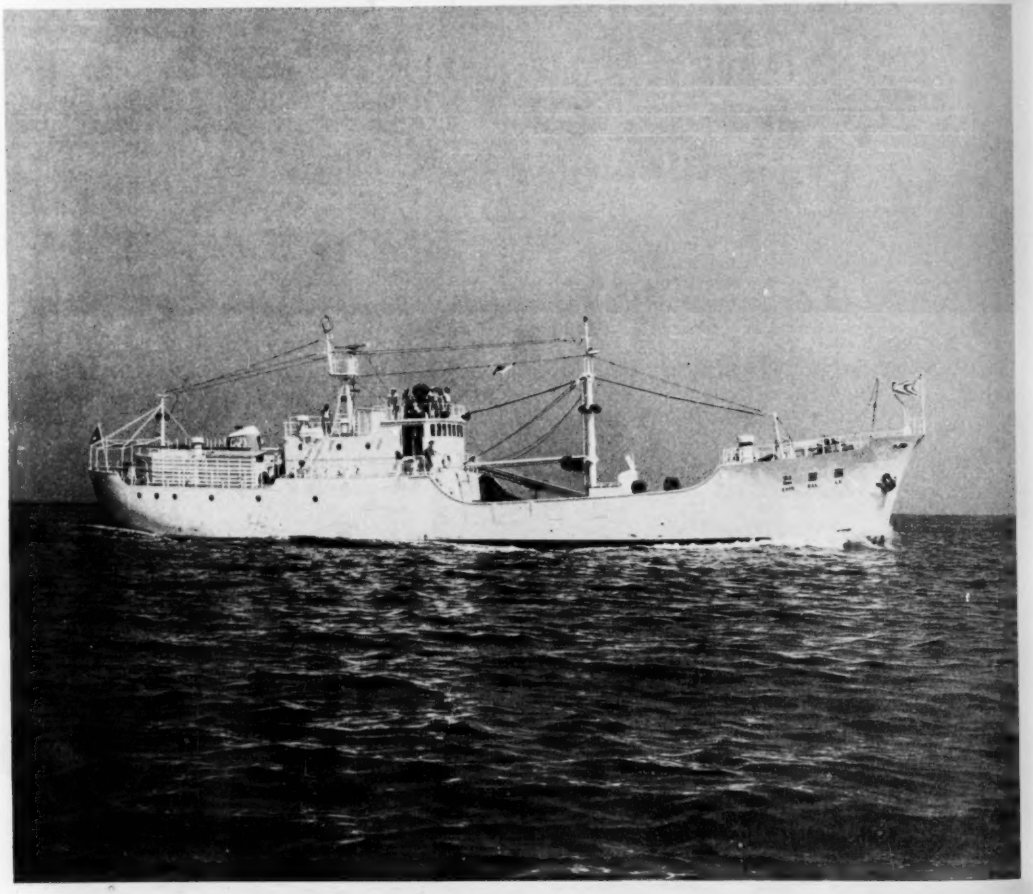
FISHING-TRAINING VESSEL

Two Japanese-built fishing-training vessels are training young South Koreans to increase their country's production. The 2 are: 'Chin Dal Le,' a 320-ton tuna longliner, and stern trawler 'Kaenali'.

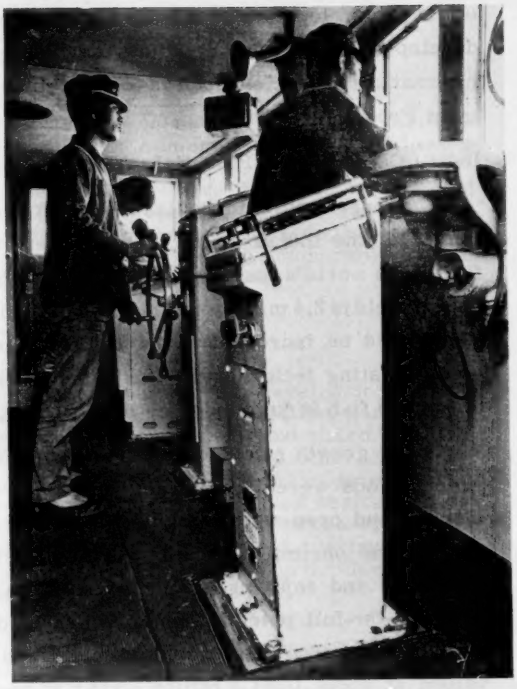
The vessels sail from Pusan Deep-Sea Training Center, a $2-million, 5-year project sponsored jointly by UN Special Fund and Korea, and FAO administered.

Pusan Center graduates are becoming backbone of growing high-seas fleet.

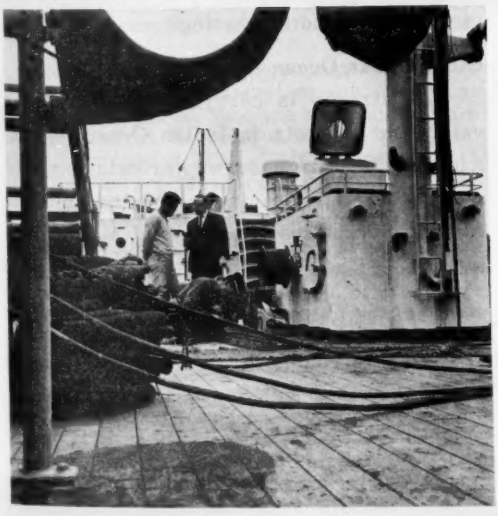
The 'Chin Dal Le', which means 'wild rose' in Korean, is combination training vessel and tuna longliner. It carries 16-man crew, 40 trainees, and FAO instructors on 4-month trips. It fishes rich tuna grounds near Samoan islands.



Trainees in engine room
of Chin Dal Le.



Trainee at the bridge.



Kare Larssen of Norway, FAO officer,
inspects repairs.

(FAO: P. Boonserm)

FAO GROUP APPROVES INDIAN OCEAN FISHERY PLAN

A 5-year plan to develop Indian Ocean fisheries to help feed millions of Asians has been approved by the Executive Committee of Indian Ocean Fishery Commission. The commission is a 26-nation FAO regional body. The committee met in Rome April 26-29.

The program provides for a comprehensive effort to develop these fishery resources by developed and developing countries, and by international agencies, such as U.N. Development Program (UNDP).

Indian Ocean's Vast Potential

A 78-page report emphasized the vast potential of the Indian Ocean, which covers a fifth of the world's marine area. The ocean's annual yield is 2.4 million metric tons of fish. This could be increased to 14 million tons using existing technology. The world catch of marine fish is just under 60 million tons.

Annual growth rates of 5% to 8% over 20-year periods were foreseen for bottom (demersal) and open-water (pelagic) fisheries. In tuna and shrimp fisheries, already well developed and enjoying strong international demand, the full potential could be achieved in 10 years. The total potential yield was valued at about US$1.8 billion a year at retail level.

Benefit Billion People

The billion people of the Indian Ocean countries--about a third the world population--would benefit. East Africa and southern and southeastern Asia have substantial protein deficits. Population growth is higher than elsewhere. Per-capita national incomes vary from under $100 to $500 a year.

Fisheries would provide valuable protein food for local use and for export, especially tuna and shrimp. These would bring more jobs and investment opportunities.

Program's First Objectives

The program calls initially for technical staff under Indian Ocean Fishery Commission. It would identify and coordinate existing development projects and promote the gathering of statistical information. It would help launch national and regional projects: exploratory fishing, fishermen training, and introduction of better methods of fish handling, distribution, and marketing.

Other Indian Ocean Projects

FAO already is carrying out fishery development projects in Indian Ocean region. Also, studies are underway or being planned along coast of Tanzania, Gulf of Jeda in Saudi Arabia, Seychelles Islands, and Maldive Islands.

FAO REVIEWS SIGNIFICANT FISHERY DEVELOPMENTS SINCE 1958

FAO has reviewed the significant developments in sea fisheries since the first UN Conference on the Law of the Sea in 1958. World fisheries have been developing rapidly. The production of marine fish (including shellfish) increased from 27 million tons in 1958 to 56 million tons in 1969. Problems of overexploitation have intensified. This has increased the need for conservation and management measures.

In 1955, virtually all fish stocks outside the North Atlantic and the North Pacific were underexploited, or not exploited at all. Now there are few stocks of fish readily caught and marketed that are not heavily exploited. Many of these are caught by large fleets of long-range vessels capable of fishing anywhere.

The number of countries fishing well beyond their own coasts also is increasing. It includes several developing countries, often as a result of assistance programs. This is an important development since the 1958 Conference because more countries with strong and sometimes conflicting fishery interests will take part in the new conference in 1973.

Many Resources Underexploited

Though many of the more valuable stocks are overexploited, some seriously, the sea's total living resources are still underexploited.

According to the FAO Perspective Study of World Agricultural Development, the total demand for fish for humans and for animals is projected at 74 million tons in 1975, and 107 million tons in 1985. This compares with an estimated potential from conventional marine species of a little over 100 million tons.

Among the policies required to reach such a target, the study emphasizes the importance of management measures aimed at more rational use of fish stocks. This is because the full potential can be achieved only if each stock is harvested at optimum rate.

More species are being fished, so management has to account more for ecological interactions between different species in same region. Effective use of fish resources requires more than maintaining at high level the yield from certain individual stocks.

Particularly for capital-scarce developing countries, the costs of harvesting must be kept low. There is increasing emphasis on economic considerations in management schemes of governments either individually or within regional fishery bodies. The introduction of certain restrictions on fishing will not necessarily be economically beneficial. Some limitation of entry into a fishery is required if fisheries are to be exploited most profitably.

Many Improvements

Improvements in fishing equipment and methods, fish handling and processing, and development of new products and markets since the first conference have brought more resources within range of commercial exploitation; they have led to important cost reductions. Technical progress, however, has not always been an unmixed blessing for fisheries--because it is accompanied by intensified exploitation.

Fish Location

The most important developments probably have been in fish location, particularly in sonar in purse seining and aimed trawling. The industry also has adopted new fishing gear and gear-handling techniques, such as midwater trawls, mechanized devices for net handling, and fish pumps. The generalized use of synthetic fibers for net construction has had a significant impact on the development of fisheries.

New freezing and processing techniques make it possible to handle and store fish on board. A large fleet of freezer and factory trawlers has been built and equipped to operate anywhere. Other characteristics of the long-range fishery are mothership operations, with one large factory vessel supported by smaller catchers, and a worldwide network of fishing ports for unloading, bunkering, repair, or exchange of crews. In the traditional small-scale fisheries, the most significant changes have been the use of synthetic fibers, mechanization of small craft, and the use of glass-fiber and ferro-cement as hull material.

Other Developments

There have been developments in other uses of the ocean, including waste disposal, and in industrial exploration and exploitation of resources of seabed and its subsoil. Many of these activities affect fishery resources and fishing activities. This increases possibility of conflicts between various uses. It becomes necessary to consider measures required to minimize any harmful interference with fishing, especially from pollutants.

More Known Today

Today, scientists know much more about the sea's living resources, and the effects of fishing on them, than they knew in 1955. Many species migrate. Fishing them in one national jurisdiction affects them in other jurisdictions and on the high seas. There is need for an integrated approach to management.

FAO Committee on Fisheries

In 1965, FAO Committee on Fisheries was set up. It is the only global forum concerned with the development of fisheries. One of its main functions is to review fishery problems of an international character. It appraises the problems and possible solution in order to concert action.

More Management Bodies

More fishery management bodies have been established to cover specific areas of the high seas or species: the Joint Commission for Black Sea Fisheries; the Northeast Atlantic Fisheries Commission; the Joint Commission for Fisheries Co-operation; the Japan-Republic of Korea Joint Fisheries Commission. The Regional Fisheries Advisory Commission for the Southwest Atlantic, the Fishery Committee for the Eastern Central Atlantic, and the Indian Ocean Fishery Commission were created within the framework of FAO.

FAO also convened two Conferences of Plenipotentiaries that adopted Conventions for establishing, outside FAO, the International Commission for the Conservation of Atlantic Tunas and of the International Commission for the Southeast Atlantic Fisheries.

Regional fishery bodies promote and coordinate research and ensure rational management of resources in their area of competence.

JAPAN

FROZEN SHRIMP MARKET FORECAST FOR DECADE

Japan will have to import an estimated 120,000 metric tons of frozen shrimp by 1980 at twice the average 1968 price (US$2,217 per metric ton). The cost: about a half billion dollars. This was predicted in a report, "Frozen Shrimp Import Vision," prepared by an advisory body of Ministry of International Trade and Industry.

This is a summary:

Demand Trends: Demand for shrimp is rising rapidly. During 1966-1970, annual growth averaged about 9%. If trend continues, demand likely will increase to 122,000 tons in 1975, and to 156,000 tons in 1980.

Price Trends: Demand is increasing faster than supply. There is "excessive competition among Japanese shrimp importers." So it is estimated that prices will double by 1980 over 1968 prices.

Production: More shrimp grounds can be developed and harvesting methods improved. Unloading facilities at many fishing ports still inadequate. Processing facilities and quality standards in southeast Asia and Middle East are poor; only India and Australia have quality control.

System of Exports in Producing Countries and Imports by Japan: Exports in most shrimp-producing countries are handled by processors, not by export agents. Few governments are involved in administering exports. In Japan, quality standards are relatively uniform for frozen shrimp imports; about 70 importers are involved.

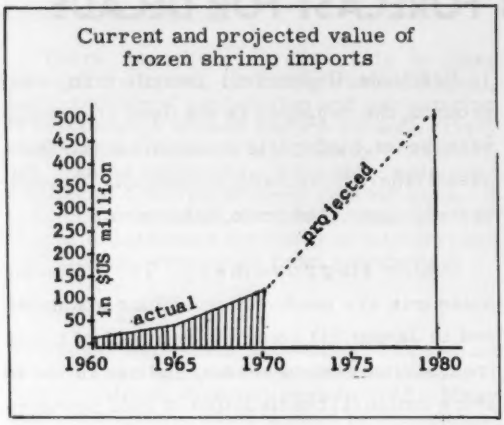
Resource Underused: Despite many rich grounds, the resource is not used effectively because of inadequate surveys. Japan must assist others financially, technically, provide vessels, gear, and train fishermen.

Quality Improvement: The following measures are needed in producing countries and in Japan; (1) complete removal of heads from shrimp aboard vessel, and use of ice to store catch; (2) construction of cold storages at ports of landing; (3) refrigerated railcars and trucks for land transportation; and (4) thorough export inspection.

Import Cost Reduction: To increase shrimp imports, Japan must reduce costs: (1) remove import tariff; (2) reduce ocean freight (very high); and (3) buy at reasonable price.

Establish Order: Raw material prices zoom whenever importers concentrate heavily in certain areas and bid up prices. These measures are necessary to avoid excessive competition: (1) develop uniform purchase contracts; and (2) work with industry to improve quality.

Government Measures Needed: (1) Eliminate import tariff on frozen shrimp; (2) provide more financial help to firms losing money developing resources in foreign countries; (3) more loans for resource development and for frozen-shrimp imports; and (4) help with surveys and technical problems. ('Shin Suisan Shimbun Sokuho', Apr. 28; 'Nihon Suisan Shimbun', Apr. 26.)



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WILL AID PERU'S FISHERY RESOURCE DEVELOPMENT

Major Japanese firms, including Mitsubishi Shoji and Mitsui Bussan, plan to help develop Peru's shrimp, crab, and coastal resources and modernize the fishing industry. The Japanese-Peruvian plan was disclosed by Fisheries Minister Tantalean during his visit to Japan as a guest of fishery and trading firms.

The Plans

Plans include capital investment of over US$10 million, jointly by Mitsubishi Shoji and Nihon Hogei, and similar investment by Mitsui Bussan. The operation will develop fishery resources and handle freezing, processing, storage, and export of fishery products.

Also planned are fishing bases and shipbuilding facilities to modernize the industry.

Although Peru harvests mostly anchoveta, its other coastal fishery resources, such as shrimp and crabs, are almost untouched. Japan plans to develop those resources by providing capital and up-to-date fishing techniques. ('Minato Shimbun', May 2.)

* * *

SHRIMP CATCH OFF GUIANAS INCREASES

The Japanese shrimp fleet fishing off the Guianas in South America consists of 70 trawlers owned by 7 firms and is based at Georgetown, Guyana; Paramaribo, Surinam; and Port of Spain, Trinidad.

The catch was 1,630 metric tons in 1968, 2,500 tons in 1969, and 3,839 tons in 1970. Of the 70 trawlers, only 10 of the 15 owned by Shinyo Gyogyo are licensed by Japan for regular commercial fishing. The other 60 are fishing "experimentally" under a 1-year renewable permit. The shrimp is processed in Georgetown and exported to the U.S. and Japan.

Plans for Joint Ventures

In Dec. 1969, the 7 Japanese firms formed the South American Marine Development Co. with authorized capital of US$278,000 (100 million yen), and paid-up capital of $69,400 (25 million yen).

The company was negotiating with the Guyanan Government and the British-owned Guyana Industrial Holding Co. to establish a joint shrimp freezing and processing plant in Georgetown. Guyana has one freezing plant: Bookers Merchants Ltd, 100% Guyanan-owned and operated, with a daily capacity of 30,000 pounds.

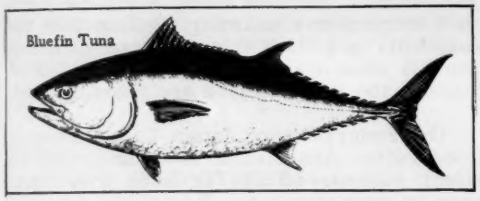
Similar negotiations were under way in Paramaribo, Surinam. The proposed undertaking there will not be possible until after Nov. 1971, when the exclusive processing rights held by Surinam-American Industries Ltd. (SAIL) expire.

SAIL built a freezing and processing plant in 1956 and obtained a 15-year exclusive concession to export shrimp from Surinam. The plant, rated very good, has a daily freezing capacity of 55,000 pounds. SAIL processes catches of Japanese shrimp fishermen under special agreement prior to export to Japan. ('Suisan Shuho')

* * *

CATCH OF SOUTHERN BLUEFIN TUNA WILL BE REGULATED VOLUNTARILY

The Japan Tuna Fisheries Cooperative Associations (NIKKATSUREN) and the Japan Tuna Fisheries Association (NIKKATSUK-YOKAI) have agreed on voluntary measures to protect stocks of southern bluefin tuna (Thunnus maccoyii).



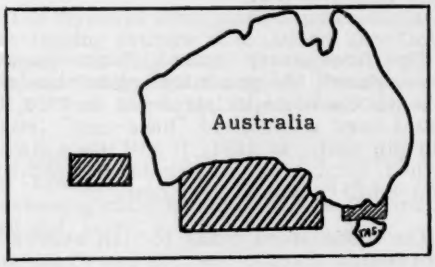
The plan will go into effect on or before Oct. 1, 1971. It will include a closed season in these areas:

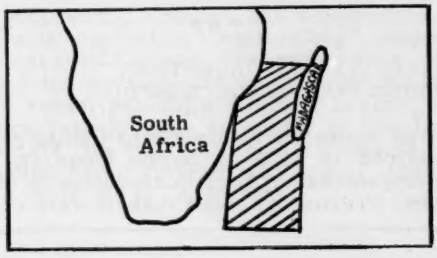
Between 120° E. and 140° E. longitudes, and between 40° S. latitude and Australia:	Oct. 1 - Mar. 31
Between 95° E. and 110° E. longitudes, and between 35° S. and 40° S. latitudes:	Dec. 1 - Mar. 31
Between 145° E. and 151° E. longitudes, and between 35° S. and 40° S. latitudes:	May 1 - July 31
Between 15° E. and 35° E. longitudes, and between 38° S. and 45° S. latitudes:	Oct. 1 - Jan. 31

The decision to establish voluntary industry regulation is important in promoting rational use of the resource. It was due partly to disclosures by the Government's Far Seas Fisheries Research Laboratory at Shimizu that southern bluefin resources might be depleted in South Pacific, Indian and Atlantic Oceans if fishery continued. Normally, 150-200 tuna longliners fish year round for the species.

Rapid Catch Drop

During past 3 years, the average daily catch has decreased rapidly. Off Australia, catches dropped from 3 metric tons in 1968 to 0.7 ton by Feb. 1969. Off Tasmania and New Zealand, the average daily catch decreased from 10-20 tons in early 1960s to less than 1 ton in 1970.





In 1971, the laboratory called for drastic measures to preserve the species because it takes 6-7 years for southern bluefin to reach adulthood. ('Suisan Tsushin' and 'Katsuo-maguro Tsushin', May 17; 'Suisancho Nippo', April 16.)

MAY REDUCE SAURY FISHERY OFF U.S. WEST COAST

The Japanese have had little luck with saury fishing off the U.S. West Coast since they began exploring these waters in fall 1969. It has dampened their interest.

In 1970, the Japanese Fisheries Agency received applications from more than 50 vessels. Only 33 received permits, and only 15 actually fished. The deadline for filing was May 31, 1971, and only a few applications had been received a month before deadline.

First Vessel's Plan

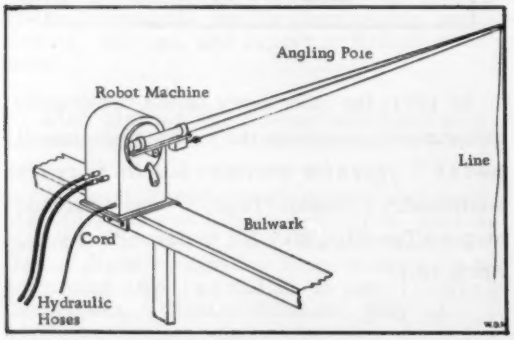
The first saury vessel, Nihon Suisan's 'Tone Maru', 535 gross tons, was scheduled to leave Hakodate in late June. In 1970, the vessel used a modified "boke-ami" (stick-held dip net). In 1971, it will use a fishing method combining stick-held dip net with "hiki-ami" (a type of drag net).

The Tone Maru plans to fish eastwards from central Pacific towards San Francisco, then proceed northward. ('Suisan Tsushin', Apr. 28.)

* * *

AUTOMATIC SKIPJACK-TUNA FISHING POLE IS SUCCESSFUL

The automatic skipjack-tuna fishing gear developed in 1970 by Suzuki Ironworks is proving successful in trials conducted by bait boats. Previously, small vessels were considered unsuitable for mechanized fishing; now they are experiencing amazing results with the automatic gear. Its use is spreading in Japan.



Robert skipjack tuna angler based on the drawing by the manufacturer, K. K. Suzuki Tekkojo, 7, Mikawa-cho, Ashinomaki, Miyagi Prefecture, Japan.

Fishing Effective

Ordinarily, 4 to 8 units are installed aboard a vessel. But one 384-ton vessel scheduled for launching in Oct. 1971 will be rigged with 16 units.

With proper chumming, fishing with the automatic gear is highly effective. The unit can lift albacore of 16-20 kilograms (35-44 pounds) the way skipjack are poled by hand.

The Federation of Japan Tuna Fisheries Cooperative Association is considering the effect widespread use of such gear would have on wage structure. It is studying proper wage scales for fishermen. ('Katsuo-maguro Tsushin', April 26)

* * *

SARDINES RETURN TO NIIGATA AFTER 15 YEARS

The Igarashihama port, in Niigata City, bustles as fishermen haul in large sardine catches. Sardine had all but disappeared from Japanese waters. The catch by about 15 boats on May 13 was large enough for fishermen to be jubilant. It was the largest in 15 years. ('Yomiuri', May 14.)

NMFS Comment: The 15-vessel catch does not seem large. The Sea of Japan sardines, which "disappeared" mysteriously after World War II, may be making a comeback. The same may be happening off the Soviet coast, where a sardine fishery flourished 20 years ago.

* * *

SALMON INDUSTRY AGREES ON 1971 PROFIT SHARING

On May 5, Japanese salmon-catcher owners and mothership operators agreed on distribution of proceeds during 1971 season. Terms include: (1) 63.5% of net proceeds will be for catcher vessels and 36.5% for mothership firms (62% and 38% in 1970); (2) the two groups will consult on selling prices and domestic sales; (3) a sales committee will be formed to improve sales system. Item 3 was

JAPAN (Contd.):

inserted because of poor 1970 salmon market in Japan. This had resulted in delays by several mothership firms in settling accounts with catcher vessels.

1970 Joint Fishing Management

In 1970, the two groups had agreed to joint management of fishing operations to provide more equitable profit sharing. Before that, the salmon fishermen had concluded predeparture price agreements each year. ('Suisan Keizai Shimbun', May 10.)

* * *

FRENCH ORDER
JAPANESE SEED OYSTERS

French oystermen in the Charante area have ordered more than 50 tons of seed oysters from Japan. They hope the strain will prove more resistant than the French oyster to the mysterious disease expected to destroy over 50% of 1971 crop in Vendee region of northwest France. French oyster culture annually produces US$2 million worth.

Oyster Breeders Warned

Claude Maurin, Director of France's Technical and Scientific Marine Fishing Institute, has warned French oyster breeders against importing Japanese oysters to replenish their beds of Portuguese oysters hit by a mysterious disease in 1971. He said: "Although the Japanese variety grows more rapidly, it runs the danger of adversely affecting its marine environment for it filters more and consumes more. . . . Above all we must avoid an ill-timed reseeding." ('Japan Times', May 3.)

* * *

BRAZIL'S 200-MILE FISHING ZONE
WILL HURT JAPANESE SHRIMPERS

Brazil's recent extension of her territorial sea to 200 miles will seriously hurt the Japanese shrimp fishery there, Japanese sources say. Some 72 shrimp trawlers of South American Marine Development Company (SAMDC), formed by 7 Japanese firms, annually catch off northeastern coast of South America about 3,000 tons (headless weight) of shrimp worth about US$11.1 million.

30% Within 100 Miles

About 30% (900 tons worth about $3.3 million) comes from within 100 miles of Brazil's coast; according to new regulations, only Brazilian vessels may fish there.

SAMDC has asked Japanese Government to negotiate with Brazil to ensure continuation of shrimp fishery in those waters. ('Suisan Tsushin', May 27.)

* * *

TO FISH SKIPJACK TUNA
WITH AUSTRALIANS

The Kyokuyo firm plans a joint skipjack-tuna-fishing venture with Australia's Gollin Company in July 1971. Kyokuyo will put up 55%, and Gollin 45% of capital. Headquarters will be Port Moresby, Papua-New Guinea.

Plans in progress are for a canned tuna and "arabushi" (sun-dried skipjack loin) processing plant in Kavieng, New Ireland Island and, later, a cold-storage plant.

Preparation Underway

At present, Kyokuyo has 4 pole-and-line vessels conducting "exploratory" skipjack fishing from Kavieng. The vessels were landing 5-ton average and up to 20 metric tons per vessel per day's fishing. In June, two more vessels were scheduled to join fleet. By 1974, the fleet will be 15-16 vessels, including purse seiners; and annual landings are projected to 50,000 tons.

1966 Joint Venture

In 1966, the 2 firms formed Gollin Kyokuyo Fishing Co. to shrimp in Gulf of Carpentaria. The venture progressed steadily. In June 1970, the firm distributed 15% dividends to shareholders.

Scheduled for June 1971 was an increase in capital from present $56,000 to $400,000. In 2 years, the Gulf of Carpentaria fleet will be expanded from 10 to 15 vessels; annual landings are estimated to reach 1,000 tons. ('Suisan Keizai Shimbun', May 31.)

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JAPAN (Contd.):

FISHING FAMILIES DECREASE, OLDER FISHERMEN INCREASE

The number of fishermen in Japan is decreasing and their average age is increasing, according to Ministry of Agriculture and Forestry's survey: "Fishing Family Employment Situation in 1970."

In 1970, there were 363,100 fishing families (3.2% below 1969). These consisted of about 1,723,000 family members (down 5.4%).

The number of workers in the fishing industry was 691,400 persons, down 6.4%; of these, 548,700 (down 4.1%) were offshore workers.

Young Group Declines

By age group, the number of fishermen 15-39 declined more (6.1%) than those 40 and over. This indicates that proportion of older fishermen is increasing.

Among fishing families, junior high school graduates totaled 43,700--22,700 were males. Of male graduates, 40.7% advanced to higher schools, 55% chose work in fishing industry, and 4.3% was unemployed.

Among male graduates entering a fishing career, 12,485, only 4,000 became offshore fishermen. ('Shin Suisan Shimbun', May 17.)

日本

TAIWAN

REMOVES IMPORT CONTROLS ON MARINE COMMODITIES

Taiwan's Bureau of Foreign Trade removed over 650 items from the controlled import list during Jan.-Mar. 1971. About 50 marine commodities are included. These now can be exported to Taiwan as "permissible import" items, including salted, dried, or smoked croakers, Spanish mackerel, tilefish, lizardfish, sea catfish, sauces, tortoise and mother-of-pearl shells, and seaweeds.

* * *

1970 CATCH ALMOST 10% ABOVE 1969's

Taiwan's 1970 catch was 613,000 metric tons, almost 10% above 1969's 560,000 tons. The largest increase was in fish culture, 27% more than 1969; the absence of typhoons and government programs helped to produce it.

The second largest increase came in distant-water fisheries (9%), especially from Taiwan-based vessels. Without these, there would have been no increase in distant-water catch because non-Taiwan-based fleet caught less in 1970 than in 1969 (93,000 vs. 94,000 tons).

Tuna Fleet Growth Slowed

In past years, tuna fleet grew fastest. But not in 1970. Tuna stocks probably were less available in 1970 than before. In heavily exploited waters off Taiwan, catch increases were held to about 6% in outer coastal waters, and only 2.5% in inner coastal waters, where pollution problems are beginning to be felt. ('China Fisheries Monthly', Feb. 1971.)

1971 Fleet Building Plans

Only moderate expansion of fleet construction is planned in 1971: 40 tuna longliners (250 GRT each).

The hulls will be constructed in Taiwan, the engines and other equipment imported. Delivery is expected at end of 1971. No more tuna vessels will be built for several years.

Construction of 12 pair trawlers (minimum 150-ton refrigeration capacity), partly financed by a $1 million government loan to fishing companies. Construction contracts have not been concluded. (U.S. Embassy, Taipei, April 15.)

EUROPE

USSR

1966-1970 SOVIET FISHERIES REVIEWED BY DEPUTY MINISTER

The Soviet Deputy Fisheries Minister has disclosed some of the accomplishments of Soviet fisheries during the 1966-70 Five-Year Plans (FYP).

The catch was 34 million metric tons (up 55% over 1961-1965), edible fishery products output 17 million tons, fish meal 1.7 million tons. In 1970, the catch was 7.7 million tons.

Among edible fishery products, fillet production increased the most (440% over 1961-65), canned products the least (48%). While catch rose 55%, per-capita consumption of fish and fishery products rose only 36.5%.

Three-fourths of all fish processing was done on the high seas. This is significant because it helps to maintain and improve the quality of fishery products.

1971-75 Plans

For 1971-75, Mr. Studenetskii indicated, the Soviets will move their fisheries away from the Continental Shelf into the deep oceans. This will require re-equipping the fleet with improved gear and building new vessel types.

Research

Mr. Studenetskii, a researcher, stressed the need for expanded and improved exploration and research for new species, fishing grounds, and better gear. He will push for more efficient and profitable techniques to fish sparsely schooling fish and other marine creatures.

Red Tape

It was apparent that red tape and other problems continued to plague the fisheries because the Deputy Minister said he planned to "weed out unnecessary bureaucracy," would demand the application of cost accounting at all managerial levels of the Ministry and industry, and pledged "improvement of quality and management of research" and planning for fleet operations. ('Vodnyi Transport')

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SOVIET BLOC TO SURVEY VALUABLE MINERALS ON OCEAN FLOOR

The Soviet Union and its allies have agreed on a program to survey and extract valuable minerals on the ocean floor. At present, there is no international authority on the exploitation of seabed resources. The Soviet-bloc plan was reported from Moscow to The New York Times on April 23, 1970.

After a 4-day conference in Riga, Latvia, a Baltic sea port, the geologists decided to establish an International Coordinating Center of Marine Exploration in the Soviet Union.

The center will be designed to insure "rational use of mineral resources of the oceans." It will be open to members of the Council of Mutual Economic Assistance, or Comecon, the economic alliance of the USSR and Eastern Europe.

A published interview with G.A. Mirlin, head of Soviet delegation at Riga meeting, disclosed that joint expeditions are being planned to select possible sites for mineral exploitation.

Oil & Gas Fields

Mirlin heads the Geology and Mineral Resources Department of the Soviet State Planning Committee, the economic planning agency. He said that exploration would aim at finding oil and gas fields, and deposits of gold, nickel, tin, titanium, cobalt, and zirconium. The Soviet land mass has limited supplies of these.

The Soviet bloc action comes after the UN General Assembly agreement in December 1970 that the seabed's riches belonged to all nations. The assembly adopted a resolution creating an international body to direct exploitation efforts.

The resolution calls for a law-of-the-sea conference in 1973 to write governing regulations. The conference will try to agree on a definition of the seabed area that would be outside national jurisdiction and under the proposed world authority.

Published reports of the Riga conference did not mention UN efforts to regulate use of seabed resources.

The conference was attended by delegations from the USSR, Hungary, East Germany, Poland, Bulgaria, Rumania, and Czechoslovakia.

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USSR (Contd.):

FISHERIES MINISTRY'S COMPUTER WATCHES FLEET OPERATIONS

The Soviet Fisheries Ministry's Main Information Center in Moscow has a huge, electrically illuminated world map divided into 22 squares. These represent the principal Soviet fishing grounds. The Center follows Soviet fisheries in all oceans. It can tell positions of fleets or individual vessels at any time.

The Ministry's control room is connected by teletype with the headquarters of the 5 Main Fishery Administrations all over USSR. A computer stores information fed daily by the Main Fishery Administrations on fishery operations. The computer also is fed data on vessels in ports or en route to the grounds. The data, retrievable instantly, are transferred to the map for visual examination.

Worldwide Hookup

The Director showed a Moscow reporter the efficiency of his Center by projecting on the map the exact location of the Soviet Far Eastern (DAL'RYBA) fleet in the Sea of Okhotsk; the Northern Administration (SEVRYBA) fleet in Barents Sea; the northwest Atlantic (off Labrador and Nova Scotia), and around the Azores--with catch data for that day.

The center is in constant radio contact with all major Soviet fishery vessels. During the interview, the Director established voice contact with captain of whaling factoryship 'Sovetskaia Rossiia' in the Pacific en route to Vladivostok.

Center Fully Operational

The Main Information Center was established in 1969 as part of the Ministry's Division for Coordination of Computer Operations. It is fully operational. Experimental computing centers in the USSR's Main Fishery Administrations are feeding the Main Center with data on fleet operations, catch, and catch projections.

NORWAY

NORDIC GROUP EXPANDS FOREIGN MARKETS FOR FROZEN FISH FILLETS

Sales of frozen fillets to the U.S. by the Nordic Group have increased considerably, reports its director. The group is composed of 13 independent fish processors in Norway. In mid-March, indications were that 1971 sales would reach 20,000 metric tons, compared to 13,000 tons in 1970.

The Nordic Group was granted Norwegian export rights in April 1968. It packs under the labels of several U.S. processors.

Frionor, which packs under its own label for shipment to its plant in New Bedford, Mass., sold 30,000 tons to the U.S. in 1970.

The director also reported considerable progress in exports to the U.K. ('Fiskaren')

SWEDEN

IMPORTS OF FISHERY PRODUCTS ROSE IN 1970

In 1970, Swedish imports of fishery products increased to 81,000 metric tons worth US$73 million--up 5,370 tons and $13 million over 1969.

Imports of fresh fish decreased 500 tons to 12,500 tons; their value rose $0.2 million to $8.5 million. Frozen fish in the round reached 4,600 tons valued at $7.6 million, up $1.1 million.

Salmon was more than $9 million of total fresh and frozen imports of $16 million. Other leading imports were halibut, plaice, ling, and mackerel.

Another large import item was frozen fillets, 17,000 tons worth $12 million--2,700 tons and $3 million above 1969.

Canned Shellfish No. 1

The largest share in import value was canned shellfish (5,600 tons) worth $13 million; this was increase of $5 million from 1969. Imports of shrimp were $7 million, and crabs almost $3 million. ('Fiskets Gang', Apr. 1971.)

ITALY

TUNA SALES FROM JAPAN ARE AT A STANDSTILL

In early April 1971, Italy established a provisional mercury guideline of 0.7 part per million, plus a 10% allowance--maximum limit of 0.77 p.p.m.--for all fresh, chilled, or frozen tuna imported into Italy. A 3-month trial inspection period was begun. From then until mid-May, the Japanese had not received a single inquiry for tuna from Italian packers.

Italian Market Uncertain

The uncertainty of the Italian market may soon affect Japanese, South Korean, and Taiwanese fleets fishing for yellowfin in the Atlantic Ocean. These fleets switched from albacore to yellowfin in Dec. 1970 following the discovery of mercury in canned tuna in the U.S. Large quantities of tuna, already aboard, were due to be unloaded in Italy in late May and in June. Fleet owners feared that a sharp price decrease in Italy would adversely affect the profitability of Atlantic operations. ('Suisan Tsushin', May 11.)

Fish stall in Rome Market. (Robert K. Brigham)

BRITISH SHRIMPING DWINDLES, PUZZLING FISHERMEN AND BIOLOGISTS

Bernard Weinraub

The shrimps are barely running on Britain's northwest coast.

Along the jagged 500-mile stretch from Silloth to Rhyl in North Wales--which accounts for half the country's shrimp yield--the rubber-booted fishermen are returning glumly each morning with either empty nets or just a few pounds to sell to local tradesmen.

"Disastrous, it's absolutely disastrous," said Alan Spencer, managing director of one of the area's chief shrimping cooperatives, Lytham and Morecambe trawlers. "Normally in this spring run we'd have caught five tons of peeled shrimp by now. Well we've caught only a ton so far."

Across the entire northwest coast, less than two tons of peeled shrimps have been caught during the current spring season, which runs from March to May. Last year the figure was 8 to 10 tons. Shrimps are normally most profuse in the late autumn from September to December. Last year 125 tons of peeled shrimps were caught in the autumn season, compared with 250 tons in the previous year.

Fisherman here refer to the shrimp as "peeled" or "picked," because the shells are quickly removed by local workers after the catch is hauled on to shore and weighed. One ton of peeled shrimp is about the same as four tons of "rough shrimp," whose shells have not yet been removed.

Biologists Move In

Teams of biologists have moved into the towns of gray stone houses and cobbled streets to check the waters of the surrounding Irish Sea for pollution. The biologists, of the Ministry of Agriculture as well as the Lancashire and Western Sea Fisheries Joint Committee, express confusion.

"The shrimp landings have been declining over the past year and the decline is widespread but we have no evidence of simple pollution," said A. J. O'Sullivan, a senior biologist with the fisheries committee, which is the offshore protection and conservation body. "If the decline was caused by a pollutant then I expect the effects would be quite severe in areas where the pollutants are in effect."

"But the decline is too widespread," he said. "We're thinking now that this could be a natural low period for shrimps and the general pollution in the area is decreasing their viability even more. We're thinking that this natural low period is being accentuated by pollution-induced effects."

In the tiny office of the shrimp cooperative in Lytham, 220 miles from London, Mr. Spencer shook his head and said: "No, we don't think it's due to direct pollution. Whether it's due indirectly to pollution is something else. It may be that pollution has killed off the weeds in the grass that the shrimps

feed on. It may be that pollution has killed off a certain amount of oxygen."

Although the northwest coast yields about half of Britain's shrimps--the rest are produced in The Wash, a broad inlet on the east coast--housewives and restaurants will not suffer since most of the shrimps eaten here are imported. The total amount of shrimp production in Britain is valued at about $480,000. Imports of frozen shrimp are worth $4.8-million while imports of canned shrimp amount to $6-million.

Mysterious and Confusing

What worries the biologists is that the causes of the skimpy shrimp harvest remain mysterious and somewhat confusing. What worries the fishermen here is that business keeps falling and unemployment climbs. Between 800 to 1,000 shrimp processors and fishermen have been laid off, including hundreds of part-time "pickers" who peel the shells. Some have been hired to work in the small "bed and breakfast" hotels in nearby Morecambe Bay, a summer golf and seaside resort.

The gloom around Morecambe Bay has deepened even further by the failure of the whitebait--young herring--catch this season, the secondary delicacy on the coast and a favorite appetizer in British restaurants.

"I've got orders for 16 tons of whitebait but so far this season we've seen only 90 pounds," Charles Bartle, manager of the Flookburgh Fishermen's Association, said, walking near the chilly surf in Flookburgh, 40 miles north of Lytham.

"Last year, the year before, we'd catch a ton each day, we'd have to ration the men," said the gray-haired fisherman.

"I'm 59 years old," he said. "I've been in this business all my life but I've never seen anything like this."

Evidence of the gloomy fishing season here is everywhere: the men sit in pubs in Lytham and Flookburgh at mid-day; the $17-a-week part-time shrimp pickers, mostly women, stand in the spotlessly clean processing rooms of factories in Lytham, bored at the absence of anything to do.

"Every day people go out two hours after high water and hope, you know, that this day will be different but they come back with nothing," said Bill Irving, a solemn, gray-haired fishing manager from northern Silloth. "It's eight hours out there and bloody nothing and it's been like that for too long now."

Reprinted from The New York Times, May 30, 1971.

TO BRITISH FISHERMEN, TRADE BLOC IS NO PRIZE

Anthony Lewis

ALDEBURGH, England. In this North Sea village you can buy your fish direct from the fishermen, at little huts on the rocky beach. W.V. (Billy) Burrell sells skate, sole, lobster, crab. On the side of his hut, just over the pile of crabs, is a sticker: "Common Market? No." That is probably a fair reading of the state of mind in Aldeburgh and all around this beautiful bleak old part of England, the bulge of East Anglia into the sea. People are talking a lot about the Heath Government's effort to bring Britain into the European Common Market, and no one sounds happy.

Billy Burrell, 46 years old and rugged, looked up from the lobster pot he was mending and explained that for him it was strictly a matter of economic survival.

"This is one of the finest fishing grounds about," he said. "As it is, there are boats from all over just beyond the 10-mile limit--Polish, German, French, Spanish, Portuguese, Belgian.

"If we get into the Common Market, you know they are going to come on in. With our little boats, we'll be in trouble."

The Aldeburgh fishermen go out in small open boats--18 feet long, but with so much ballast to cope with the rough water that they weigh two tons. There is no harbor; the boats are winched right up on the beach.

"There are not enough fishermen in Aldeburgh to get in the paper," Mr. Burrell said, but it's been going on from father to son a long time, catching fish the same way.

"I work 7 days, 18 hours a day. I'm not complaining. We get our living--a good living. But it's our livelihood that's at stake."

In fact, the British Government is far from oblivious to the fishermen. Their worries are a major issue for the next and, it is hoped, the last round of the Common Market negotiations to be held in Luxembourg. The Government is insisting that British fishermen be allowed to keep exclusive rights out to a six-mile limit.

(The New York Times)

Would a regulation like that satisfy Mr. Burrell?

"Yes, I think so. And I believe they will have a regulation. It's only as it affects our livelihood that I object."

Not everyone is so moderate about it, so ready to adapt. Tim Forge, co-director of the Uplands Hotel, makes clear that it is a philosophical matter with him. Mr. Forge, 65, was a rugby star, a schoolmaster and a tea planter in Assam before he got into hotels.

Did he agree with the objectors?

"Yes," the vicar said. "I feel strongly in sympathy with them. I think if it does happen, it will be the end of the Conservative party as we know it."

"This part of England has been invaded 11 times, you know, and people don't like strangers much," he added.

Reprinted from The New York Times, June 16.

But wasn't the last of those invasions hundreds of years ago?

"Yes," he said, "but you have to live here a time to know how people still feel about it. They have long memories."

It is hard to say how many are really irreconcilable, how many looking for reassurance from the Government. But there clearly are a lot of people who are ready to be persuaded.

On the road from Aldeburgh, at a railway crossing in the village of Leiston, was James Callaghan of the Labor Party, a critic of the market, who was speaking to a handful of the faithful in the pouring rain.

On the fringe of the small crowd two housewives who did not give their names said it was prices that worried them about joining. But they thought it was probably going to happen anyway; they just wished Prime Minister Heath or someone could explain it better.

The other big subject of conversation around here, unavoidable at this time of year, is the Aldeburgh Festival. That again is not only an international musical event but something intensely local, intimate, with the flavor of this fishing village.

Billy Burrell has known the festival's inspirer and director, Benjamin Britten, for many years and, through him, others who have taken part. E.M. Forster, who worked on the libretto for Britten's opera "Billy Budd," used to spend weekends in the Burrell home.

"I knew Forster 25 or 30 years," Mr. Burrell said. "He was one of the best, always willing to listen. A man so great and yet so humble--nothing put on, on his side or mine."

"Peter (Pears) and Ben are the same--they've never got above themselves," he continued. "My son is a godson of Ben's. I remember he gave me a copy of the "Billy Budd" score, inscribed: 'To Billy B., for B.B., from B.B.'"

Each plastic fish box aboard this small English vessel holds 50 kilos.

SOLE FOOD--SPECIALTY FOR SLIMMERS

Diet time can be pleasure time with fish and shellfish on the menu. All fishery products offer high nutritive values and most of them are low in fat and calories. Fish fillets are especially appropriate for dieters because they can be easily portioned to conform with diet plans. And they are readily available either fresh or frozen.

Sole fillets are fine eating with firm, white, delicately flavored flesh. They cook quickly because they are rather thin and adapt well to rolling or stuffing. Sole fillets vary in weight from 2 to 4 ounces, occasionally up to 8 ounces. One might say that sole fillets are filler-slimmers because their high protein content fills you up while you are slimming down.

Sole are members of an amusing family of fish called flatfish, whose characteristics make them distinctive from other species. These funny fish, shortly after beginning life, change from the average fish shape to a flat shape that, strangely enough, resembles a flying saucer. Their bizarre shape, however, does not alter their wonderful taste or exceptional food values.

Saucy Sole, a National Marine Fisheries Service recipe, presents the fillets broiled with a tasty sauce to keep them moist. The sauce, believe it or not, uses mayonnaise (diet) and chili sauce blended together with celery salt, dry mustard, and wine vinegar for added zest. About 8 to 10 minutes cooking is all that is needed, and this feast of Saucy Sole is ready to enjoy. So good--you'll forget that it's diet recipe until you remember the calorie content which is only an approximate 175 calories per serving.

SAUCY SOLE

2 pounds sole fillets or other thin fish fillets, fresh or frozen
2 tablespoons butter or margarine, melted
½ cup low calorie mayonnaise
2 tablespoons chili sauce
½ teaspoon celery salt
½ teaspoon dry mustard
½ teaspoon paprika
½ teaspoon wine vinegar

Thaw frozen fillets. Skin fillets and cut into 6 portions. Place fish in a single layer on a well-greased bake and serve platter, 16 by 10 inches. Pour butter over fish. Combine mayonnaise and seasonings. Broil fish about 4 inches from source of heat for 5 minutes. Spread mayonnaise mixture over fish. Broil 3 to 5 minutes longer or until fish flake easily when tested with a fork. Makes 6 servings.

Live it up while slimming down--it's easy with seafoods! For 22 slimming moods with seafoods, send for "Seafood Slimmers," a NMFS full-color booklet designed especially for you, the dieter. For your copy, send 25¢ to the Superintendent of Documents, U.S. Government Printing Office, Washington, D.C. 20402 and ask for "Seafood Slimmers," Fishery Market Development Series No. 7 (I 49.49/2:7).

Also available, and this time it's free, is a colorful little brochure containing four slimming recipes from the well-known Weight Watchers International, Inc., as well as five Bureau seafood recipes. For your copy, write to Stay Slim, Texas Parks and Wildlife Department, John H. Reagan Bldg., Austin, Texas 78701. (National Marketing Services Office, NMFS, U.S. Dept. of Commerce, 100 East Chio St., Rm. 526, Chicago, Ill. 60611.)

START CRABBING--THIS IS THE YEAR!

Mother Nature is in a bountiful mood--she has gone all out this year in providing a good supply of blue crabs for our eating enjoyment. Excitement is running high all along the Atlantic and Gulf coasts where fishermen are pulling the tasty crabs out of the waters of bays and sounds. Gourmets have their favorite recipes out, and crab kettles are steaming in readiness for these treasures. It isn't necessary to be a crabcatcher, however, in order to be a crabeater. Seafood markets will soon reflect this abundance and the succulent blue crabmeat will be readily available.

Blue crabs, named for the bright blue on the claws of the male crabs, are delicious eating and are an excellent source of high-quality protein, while being low in calories. Blue crabmeat is marketed already cooked, refrigerated, and ready to use in 12 or 16 ounce cans as lump meat, flake meat, a combination of lump and flake, and as claw meat. Blue crabmeat is also pasteurized, a method that gives longer shelf life without altering taste or texture of the meat. Pasteurized crabmeat must be refrigerated, however, until used. Hard-shell crabs are sold alive in some areas. Soft-shell crabs, relished by gourmets, are blue crabs in the molting stage when the hard shell is discarded in order for the crab to grow.

Crab Melon Ring Salad, a NMFS recipe is a summertime taste sensation. For this recipe and How To Cook Crabs (I 49.39:10) which describes the different kinds of edible crabs in the U.S. and gives information and recipes for preparing crabmeat, send 20¢ to the Superintendent of Documents, U.S. Government Printing Office, Washington, D.C. 20402.

CRAB MELON RING SALAD

1 pound blue crabmeat, fresh, frozen, or pasteurized, or other crabmeat
$\frac{1}{2}$ cup Lime Mayonnaise
6 cantaloupe or other melon rings
Salad greens
1 pint strawberries or other fresh berries
Frozen Lime Mayonnaise Flowers

Thaw frozen crabmeat. Drain crabmeat. Remove any remaining shell or cartilage. Combine Lime Mayonnaise and crabmeat. Chill. Place melon rings on salad greens. Place approximately $\frac{1}{3}$ cup crab mixture in the center of each ring. Cut large strawberries in half and arrange on melon. Place Frozen Lime Mayonnaise Flowers on top of crabmeat. Makes 6 servings.

Lime Mayonnaise

$\frac{1}{4}$ cup mayonnaise or salad dressing
3 tablespoons heavy cream, whipped
2 tablespoons lime juice
$1\frac{1}{2}$ teaspoons grated lime peel

Combine all ingredients. Chill. Makes approximately $\frac{3}{4}$ cup dressing.

Frozen Lime Mayonnaise Flowers

$\frac{1}{4}$ cup Lime Mayonnaise
Green food coloring

Combine Lime Mayonnaise and a few drops green food coloring. Spread $\frac{1}{4}$ inch thick in a small shallow pan. Freeze until firm. Cut into flowers. Makes 6 flowers.

(National Marketing Services Office, NMFS, U.S. Dept. of Commerce, 100 East Ohio Street, Room 526, Chicago, Ill. 60611.)